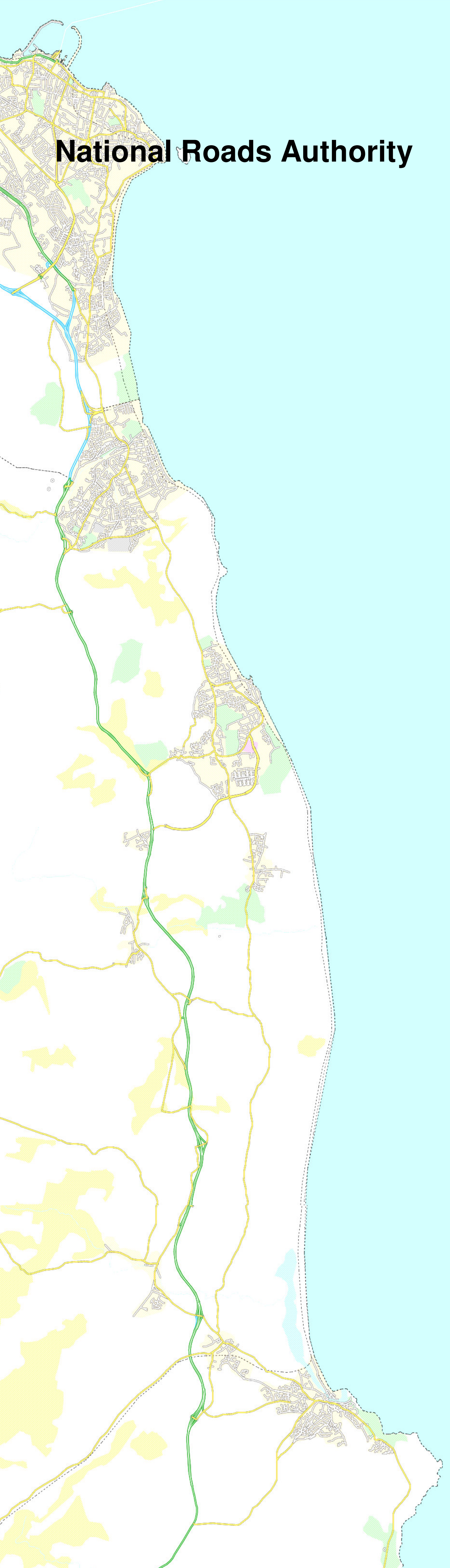
National Roads Authority



Project: National Traffic Model

Model Validation Report

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1.0 Introduction

1.1 Background

The National Roads Authority is the statutory body in Ireland with the responsibility for national roads. Over the next ten years the Authority intends to deliver a significant national road investment programme. To assist in the delivery of this ambitious programme the Authority engaged the Roughan & O'Donovan AECOM Alliance, Goodbody Economic Consultants and Tiros Resources to develop a strategic traffic model of Ireland's national road network. This strategic traffic model was to build on, incorporate and further develop a separate traffic model previously developed to cover the Leinster area. The traffic model would also allow the Authority to undertake an analysis of the national roads requirements post completion of Transport 21 taking into account projected population, employment and economic growth and consequential growth in traffic.

This report details the development of the Base Year (2006) Traffic Model, describing data collected, the choice of model software, network and matrix development, and calibration/validation of the model for the Base Year.

1.2 Report Structure

Chapter 2 – Selection of Model Software

Chapter 2 provides a discussion of alternative software packages which were considered for the National Traffic Model. A comparative assessment of alternatives has been based on an understanding of the requirements of the final model, leading to the selection of a preferred software platform.

Chapter 3 – Data Collection

Chapter 3 provides a discussion of the data that has been collected with which the base trip matrices have been developed. Locations and collection methods are described for survey data, and a discussion of other data sources (namely data from the 2006 Census) is also provided.

Chapter 4 – Network Development

Chapter 4 describes the development of the Base Year Road Network, outlining the extent and complexity of the network that has been incorporated into the traffic model.

Chapter 5 – Matrix Development

In Chapter 5, the process of matrix building is explained, describing how the different datasets have been compiled into a raw 2006 Base Year matrix. The matrix smoothing and infilling is also summarised, as is the development of a process to construct synthesised matrices.

Chapter 6 – Model Calibration

The calibration process is set out in Chapter 6, and sets out how the raw matrix has been manipulated to achieve an appropriate fit between observed and modelled data. Reference is made to the guidance set out in the Design Manual for Roads and Bridges in order to inform the model calibration process.

Chapter 7 – Model Validation

Finally, Chapter 7 describes the model validation process, comparing the final Base Year Matrix to an independent dataset, hence confirming the accuracy of the Base Year Traffic Model. Again, reference is made to the Design Manual for Roads and Bridges in the validation process.

2.0 Selection of Model Software

2.1 Introduction

In developing the National Traffic Model, a review has been undertaken to ascertain the most appropriate software platform upon which to base the model. This review follows continuing use of the SATURN software for the Dublin City model, subsequently extended to the Leinster Model. The National Traffic Model is a significant evolution on these previous models, and hence such a review is appropriate.

2.2 Modelling Options

A summary of the different available modelling suites that have been considered for the National Traffic Model is outlined below:

- SATURN (WS Atkins)
- TRIPS/CUBE (Citilabs)
- VISSUM (PTV Vision)
- EMME/2
- TRANSCAD

2.3 Technical Review

The technical review of the respective software packages has focused on the following elements, and has been up-dated to take into account recent developments:

- Highway network modelling capability
- Public transport network modelling capability
- Integration of highway/PT modules
- GIS linkages
- Demand modelling
- Integration with other packages

A detailed comparative assessment was undertaken to understand the relative merits of the different models. In summary, the following was concluded:

- That in the short term SATURN is likely to remain the primary choice for modelling of congested urban areas. Nevertheless, in urban areas pressure is increasingly being exerted by Microsimulation Models, and now by VISUM for the UK West Midlands model. Additional choice will be available by TRIPS once the new version is proven and accepted. INRO are also developing a dynamic assignment module for EMME/2 but have yet to release any specific information and, since receiving an offer to demonstrate the approach over six months ago, nothing more has been forthcoming. The strength of SATURN is predominantly based on its ability to model congested urban networks, and as such the use of SATURN for strategic modelling is less appropriate;

- That in the short term EMME/2 will remain a key player for modelling Public Transport simply as a reflection of the existence of recently developed models for major PT players. However the algorithm is now dated and the new procedures in TRIPS will make it an attractive alternative. PTV have recently responded to the needs of users and made significant improvements in their PT algorithms and VISUM is now being considered a viable alternative. There is limited benefit in switching to EMME/2 if this Public Transport capability is not required in the short term; and

- That as a total integrated package ranging from GIS through strategic modelling to simulation and operations VISUM is the most complete package. Whilst TRIPS has similar functionality, and is highly powerful for complex modelling tasks, it does not have the same presentation capabilities as VISUM.

2.4 Current Experience with Relevant Models

An estimate of market presence for TRIPS has been made (2003) and included in Table 2-1 which compares the number of VISUM, TRIPS and EMME/2 users on a world wide basis. The VISUM information is based on data supplied by PTV at a distributors meeting and the EMME/2 data is based on User Notes in 2003.

Table 2-1 Current Experience with Relevant Models

Country/Region	VISUM Users	EMME/2 Users	Citilabs Users
Germany	294	20	
Austria/Switzerland	40	13	
Northern Europe	66	140	
Italy, Portugal, Spain, Turkey	57	55	
Eastern Europe	26	17	
North/South America	22	290	
Asia	21	121	
Australia, New Zealand	0	43	
Others	6	4	
Total	**532**	**703**	**c. 1100**

Although there are more EMME/2 users world-wide, VISUM has nearly 500 European Users compared to 250 EMME/2. The European users of VISUM, outside of the UK and Germany, are mainly in France. Nevertheless, Citilabs with TRIPS, TRANPLAN and MINUTP has significantly more installations than either VISUM or EMME/2 and although there is no access to the geographical distribution it is known to be worldwide. A best estimate would be that there are probably around 300 users in Europe and 700 overseas.

SATURN is predominantly used in the UK and isolated other locations including Ireland. It retains a large user base in the UK and is the dominant package in terms of highway network modelling, particularly for urban areas.

2.5 Conclusion

On the basis of the above review it is concluded that:

- SATURN, although a popular tool, survives mainly as a result of its ability to model congested urban areas. Its graphical capabilities are poor and it provides limited advantages for strategic modelling;

- TRIPS retains good worldwide distribution, and has good functionality. Nevertheless, its graphical interface is somewhat inferior to VISUM;

- EMME/2 is somewhat dated, and its functionality focuses mainly on Public Transport Modelling; and

- VISUM is growing as an alternative, and its integration with NAVTEQ will greatly simplify the development stage of model development, particularly for larger scale strategic models.

As such, it is recommended that VISUM be adopted for the development of the National Traffic Model. VISUM has been shown to be technically appropriate for the type of work being proposed, but with a superior GIS interface, allowing high quality presentation of results. VISUM has also been shown to have a substantial user base, and is developed by an organisation that has shown an ongoing commitment to the development and improvement of this software.

As a final note, VISUM has been employed as part of the development of the following comparable models in the UK:

- PRISM West Midlands Strategic Transport Model;
- Inverness Transport Model;
- Major model of part of London (VALID); and
- Multi-modal study for DfT of routes in the East Midlands

3.0 Data Collection

3.1 Introduction

This Chapter of the report sets out the data that has been collected for the purpose of developing the Base Year (2006) Traffic Model. It describes collation of data from the following sources:

- Journey to Work (POWCAR) information from the 2006 Census;
- Origin Destination Surveys, obtained through Roadside Interview; and
- Volumetric Counts, obtained by automatic counters.

3.2 Journey to Work (POWCAR)

3.2.1 Overview

The Census database of journey to work trips was released in late 2007, and reports all journeys to work by DED for 2006. This information can be extracted for input to traffic models, thereby giving good Origin-Destination information without the necessity for widespread Roadside Interview Surveys. The POWCAR information also provides travel mode and time of departure, thereby allowing journeys by car during the AM Peak to be isolated.

The compilation of the POWCAR information to a Journey to Work Trip Matrix has followed the subsequent procedure:

3.2.2 Import to MS Access

The data was imported into .mdb format. A total of 1,834,472 records were imported. In importing the information, a number of errors were noted and corrected as follows:

Highest level of Education:	Blank card inserted. No impact on data
Nature of Occupancy:	Blank card inserted. No impact on data
Resident Persons:	Blank card inserted. No impact on data
Means of Travel:	Blank card inserted. Appeared only where place of work is not decipherable. This is accounted for through subsequent factor

3.2.3 Identifying Useable Results

According to CSO, the workforce comprises 1,930,042 persons. Some key totals are outlined below:

Total number of Journey to Work Records:	1,834,472
Missing records	+ 95,570
Total	*1,930,042*

It is therefore necessary to factor the available dataset to account for missing records, those who did not successfully code a place of work, or those with a variable place of work. This procedure is outlined below:

Total number of Journey to Work Records:	1,834,472
Place of Work not decipherable	- 137,873
No fixed Place of Work	- 208,548
Total number of usable Census Records	*1,488,051*

An aggregate factor of 1.29703 can therefore be applied to usable records to reflect the total journey to work trips. Nevertheless, it was observed that the pattern of missing records varied by county, and hence county-specific factors have been determined to account for incomplete datasets.

3.2.4 Extracting Peak Trips

The AM Peak traffic model is a Peak Period Model, modelling the average hour within the period 07:00 – 09:00. The POWCAR data identifies the time of departure for work trips in half hour intervals throughout the morning. In identifying the relevant JTW trips on the network, the following assumptions are made:

- Trips departing between 07:00 and 09:00 are valid trips and are included;
- Trips departing before 07:00 may be on the network during the 07:00 to 09:00 period. Conversely it is noted that trips departing just before 09:00 may not be on the network for much of the 07:00 to 09:00 period. It is assumed that both these overlaps cancel each other, and that only trips departing between 07:00 and 09:00 should be included; and
- Trips during the modelled period (1 hour) are achieved by dividing the 07:00 – 09:00 period by 2.

It is noted that the POWCAR dataset provides data only for the AM Peak Period. It is of limited use in the development of the Inter Peak Matrix, when Roadside Interview Data represents the main input into the development of the trip matrices.

3.2.5 Converting to a 'Typical Day'

Even with the reduction of the POWCAR data to the Average Peak Hour, it was evident that the number of work trips in the POWCAR data exceeded that which was observed in the Origin Destination surveys. This results from two effects:

- The Census requested users to enter their usual place of work, and does not account for those who were absent from work on a particular day; and
- The Census does not distinguish between those who work every day, and those who work on only certain days of the week.

A net reduction factor of 23.5% (10% to reflect the number of people who travel to work on a typical weekday, and then by a further 15% to reflect typical attendance rates) was therefore identified as appropriate to factor down the overall POWCAR matrix. Examining the resulting assignment, this reduces the proportion of Journey to Work trips during the AM Peak to 70% of total trips, which is consistent with the findings of the Roadside Interview surveys.

3.3 Origin Destination Surveys

Following initial exploration of a number of alternative forms of data collection, it was agreed that road-side interviews would be the chosen method of data collection. This decision was made due to the high response rate that is achievable and the reduced likelihood for error due to the interviewer being present to deal immediately with any queries. Nevertheless, it was recognised that the extent of the road side interviews would need to be comprehensive to produce an accurate model and would therefore require the inclusion of all national primary, secondary and regional roads and all major links and distributor roads to significant towns and cities throughout the country.

Survey locations have been selected on their strategic position to capture the potential maximum number of trips within the vicinity. The data collection would exclude the Leinster region due to data been available from previous work and other sections of the road network where RSIs were undertaken as part of NRA/Local Authority road schemes. The sites have been selected based on;

- Proximity to populated urban areas;
- Connectivity to significant urbanised populated areas; and
- Hierarchy of road network.

The population of towns and rural areas has been taken from the Preliminary Census results (CSO, 2006). Surveys locations have been chosen on roads connecting to towns where the population is greater than 7,000 and from rural areas to significant towns/rural area where the population of the rural areas is greater than 8,000.

Generally the surveys took place from Monday to Thursday and excluded the Bank Holiday that occurred during the survey period. The surveys took approximately 3 weeks to complete and extended from Donegal in the northwest to Killarney in the southwest of the country. Drivers were asked the following questions;

- Origin;
- Destination; and
- Trip Purpose.

The interviewer also recorded the following information during the course of the interview:

- Time of interview;
- Classification of Driver: Male or Female;
- Vehicle Type; and
- No. of people in vehicle.

Origin and destination addresses were then converted to the equivalent DED number defined within the model. MapInfo GIS software was used to undertake a logic check, whereby origins and destinations for each site were plotted on background base mapping to visually check that origins and destinations were on opposite sides of the interview site; and investigated if otherwise. The information was stored in an Excel spreadsheet for each individual RSI site for the AM, Midday and PM peak hours. The DED numbering system uses the 2006 CSO Enumeration Districts such that information could be easily compiled with CSO data to complete the matrix development process.

Table 3-1 details the location of the RSIs which were undertaken for the National Traffic Model. Histograms detailing the hourly traffic flow at each RSI site, and tables showing sample rates by site are included in the Traffic Survey Report.

Table 3-1 Roadside Interview Survey Locations

Road Ref	Road Type	General Location Description	Nearest Major Town	County
N14	Primary	East of Letterkenny - West of intersection w/N13	Letterkenny	Donegal
N15	Primary	Northeast of Donegal - Southwest of Ballybofey	Donegal	Donegal
N16	Primary	Intersection w/N15/N16 - North of Sligo Town	Sligo	Sligo
N4	Primary	South of Sligo Town	Sligo	Sligo
N5	Primary	West of Charlestown - East of Swinford	Swinford	Mayo
N56	Secondary	South of Foxford intersection w/R321 - North of Bellavary	Sligo	Sligo
N5	Primary	East of Westport - West of Castlebar	Castlebar	Mayo
N84	Secondary	South of Ballinrobe - West of Kilmaine	Ballinrobe	Mayo
N61	Secondary	North of Roscommon at Four-Mile House	Roscommon	Roscommon
N60	Secondary	Northwest of Roscommon - Southeast of Castlerea	Roscommon	Roscommon
N59	Secondary	Northwest of Galway City - Southeast of Moycullen	Galway	Galway
N17	Primary	Northeast of Galway City at intersection w/N63	Galway	Galway
N6	Primary	East of Galway City west of intersection w/N18	Galway	Galway
N18	Primary	South of Gort	Gort	Galway
N62	Secondary	Northwest of Roscrea	Roscrea	Tipperary
N7	Primary	East of Mountrath	Portlaoise	Laois
N18	Primary	Clarecastle - Southeast of Ennis	Ennis	Clare
N7	Primary	North of Birdhill - North of Limerick	Limerick	Limerick
N24	Primary	Northwest of Pallas Green - Southeast of Limerick	Limerick	Limerick
N84	Primary	North of Cashel - South of Horse & Jockey	Cashel	Tipperary
N24	Primary	West of Carrick-on-Suir	Carrick-on-Suir	Tipperary
N25	Primary	West of Waterford intersection w/R682	Waterford	Waterford
N72	Secondary	North of Dungarvan - West of intersection w/R672	Dungarvan	Waterford
N8	Primary	Kilbeheny - Northeast of Mitchelstown	Mitchelstown	Cork
N20	Primary	Newtwopothhouse - North of Mallow	Mallow	Cork
N72	Secondary	East of Mallow - West of Castletownroche	Mallow	Cork
N20	Primary	Blarney intersection w/R617	Blarney	Cork
N25	Primary	East of Midleton - West of Castlemartyr	Midleton	Cork
N71	Secondary	Northeast of Bandon - Southwest of Innishannon	Bandon	Cork

N22	Primary	Intersection w/N22/N72 - Southeast of Killarney	Killarney	Kerry
N71	Secondary	South of Killarney - North of Muckross	Killarney	Kerry
N70	Secondary	West of Kilorgan	Kilorgan	Kerry
N21	Primary	East of Tralee	Tralee	Kerry

A map showing survey locations, and including those surveys referenced as part of the Leinster Model in 2006 is included as Appendix A.

3.4 Volumetric Counts

A series of volumetric counts were also undertaken to assist in the matrix development. ATC's were generally undertaken from late April to late May 2007. Data was recorded continuously for a 4 week period. The following vehicle classifications were used:

- Car
- Light Goods Vehicles (LGV)
- Public Service Vehicles (PSV)
- Motorcycles (MCL)
- HGV 1
- HGV 2

Table 3-2 details the location of the Automatic Counters which were undertaken for the National Traffic Model. Further information on the traffic surveys is included in the Traffic Survey Report.

Table 3-2 Volumetric Count Survey Locations

Road Ref	Road Type	General Location Description	Nearest Major Town	County
N59	Secondary	Culleens - North of Ballina	Ballina	Mayo
N59	Secondary	East of Crossmolina - East of Ballina	Ballina	Mayo
N4	Primary	Drumfin - South of Collooney	Sligo	Sligo
N26	Primary	Callos - Northwest of Swinford	Castlebar	Mayo
N17	Primary	Lurga - South of Charlestown	Castlebar	Mayo
N5	Primary	Northeast of Bohola - Southwest of Swinford	Castlebar	Mayo
N5	Primary	Southwest of Turlough - Northeast of Castlebar	Castlebar	Mayo
R311	Regional	Southeast of Newport - Northwest of Castlebar	Castlebar	Mayo
N59	Secondary	North of Westport - South of Newport	Westport	Mayo
N17	Primary	North of Knock - South of Kilkelly	Knock	Mayo
N83	Secondary	North of Ballyhaunis - South of intersection w/N17	Ballyhaunis	Mayo
N61	Secondary	Cloonyquin - North of Tulsk & intersection w/N5	Roscommon	Roscommon
N5	Primary	East of Strokestown - West of Scramoge	Roscommon	Roscommon
N60	Secondary	Southwest of Ballyhaunis - East of Claremorris	Claremorris	Mayo

N84	Secondary	North of Ballinrobe - South of Ballintober	Ballinrobe	Mayo
N17	Primary	North of Tuam - South of Milltown	Tuam	Galway
N83	Secondary	North of Tuam - South of Dunmore	Tuam	Galway
N63	Secondary	South of Roscommon - North of Athleague	Roscommon	Roscommon
N59	Secondary	South of Clifden - West of Recess	Clifden	Galway
N84	Secondary	North of Galway - South of Castlequarter	Galway	Galway
N17	Primary	Northeast of Galway - South west of Claregalway	Galway	Galway
N18	Primary	South of Claregalway - Intersection w/R339	Galway	Galway
N6	Primary	East of Loughrea	Galway	Galway
N65	Secondary	Southeast of Loughrea - Northeast of Killimor	Galway	Galway
N18	Primary	North of Roevehagh - South of Ardrahan	Galway	Galway
N66	Secondary	Southwest of Loughrea - Northeast of Gort	Gort	Galway
N85	Secondary	Northwest of Ennis - Southeast of Inagh	Ennis	Clare
N68	Secondary	Southwest of Ennis - Northeast of Lissycasey	Ennis	Clare
N70	Secondary	South of Tralee - North of Castlemaine	Tralee	Kerry
N23	Primary	Southeast of Tralee - Northeast of Farranfore	Tralee	Kerry
N72	Secondary	West of Killarney - East of Beaufort	Killarney	Kerry
N72	Secondary	West of Mallow - East of intersection with R576	Mallow	Cork
N70	Secondary	East of Sneem - West of Kenmare	Kenmare	Kerry
N71	Secondary	South of Bantry - North of Ballydehob	Bantry	Cork
N71	Secondary	Leap - East of Skibbereen	Skibbereen	Cork
N71	Secondary	Northeast of Clonakilty - Southwest of Bandon	Bandon	Cork
R600	Regional	North of Kinsale	Kinsale	Cork
N8	Primary	North of Littleton - South of intersection w/N75	Thurles	Tipperary
N74	Secondary	West of Cashel - East of Tipperary	Cashel	Tipperary
N24	Primary	Southeast of Tipperary - Northwest of Cahir	Cahir	Tipperary
N24	Primary	East of Carrick-on-Suir - West of Fiddown	Carrick-on-Suir	Tipperary
N10	Primary	South of Killkenny - North of Stonyford	Kilkenny	Kilkenny
R675	Regional	North of Tramore - South of Waterford	Waterford	Waterford
R684	Regional	North of Dunmore East - South of Waterford	Waterford	Waterford

A map showing survey locations, and including those surveys referenced as part of the Leinster Model in 2006 is included as Appendix A.

4.0 Network Development

4.1 Introduction

The main source of network information for the National Traffic Model was sourced from NAVTEQ data. NAVTEQ data provides detailed information on all existing roads throughout the country at all levels of complexity, with information on road type, speeds and distances. The NAVTEQ information also provides geographical data for all roads which allows the data to be input directly to a VISUM network file.

Nevertheless, the NAVTEQ information leads to a 'Raw' network dataset, which requires significant processing to ensure that it is suitable for use in the current application. This section describes the extent of the network that has been imported to the National Traffic Model, the work undertaken to refine this network, and the relevant checking of the final network.

4.2 Importing NAVTEQ Data

The first phase in developing the network was to import the NAVTEQ data into VISUM and define the network parameters that would be used throughout the model development.

The NAVTEQ data has a pre-defined set of network parameters which were altered to reflect Irish conditions, such as left hand drive and the metric system of length and speed. The most significant network parameters to be defined were the system of co-ordinates which are used throughout the network development for importing and exporting GIS data. The Irish National Grid Co-Ordinates (Irish National Grid/GCS TM65) were used as the network system of co-ordinates.

4.3 Network Coding

As stated above, the importing of the NAVTEQ data only leads to a 'Raw' network which needs to be coded in greater detail to produce a network which can be used as part of the modelling process. The coding of the network consists of several key elements which can be grouped under two sections, network links and network nodes. These two sections are discussed in greater detail below.

4.3.1 Links

The following details outline the strategy used in the coding of all links in the model network. The process is broken down into several key stages, as follows:

Stage 1 – Transport Systems
There are only three transport systems included in the National Traffic Model, Car, HGV and POWCAR. Although there are three transport systems there are only two modes of transport included in the model, Car and HGV. Therefore all links in the model network have been coded to allow the use of both Cars and HGV's. Transport systems can easily be blocked from using particular links as required.

Stage 2 – Link Classification
Each link in the modelled network has been classified based on the NRA classification of

link types. The model network can be grouped into five key link types:

Motorways;
National Primary Roads;
National Secondary Roads;
Regional Roads; and
Local Roads.

It must be noted that only a select number of local roads have been included in the modelled network. These roads particularly in urban areas may carry a significant amount of traffic during peak hours and as such have been included in the network to give a more accurate distribution of traffic on the network. As a rule, roads included comprise all National Primary, National Secondary and Regional Roads.

Stage 3 – Link Capacity & Number of Lanes
All links in the modelled network have been coded to include their link capacity which is based on a 1 hour capacity derived from the Highway Capacity Manual. Also the number of lanes on each link type has been included in the network. In total there are 40 different types of link include in the network. Table 4-1 below illustrates the different link types and their characteristics including:

Link Type Number;
Link Description;
No. of Lanes;
Link Capacity (v/hr); and
Free Flow Speed (kph).

4.3.2 Nodes

Due to the strategic nature and size of the model, it was necessary to make several assumptions which globally affect all nodes in the model network. These are as follows:

Control Type - The control type at all nodes is set to unknown;
Turning Movements - All turning movements are possible at each node;
Priority – Priority is given to the major flow at each node;
Transport Systems – All turning movements are open to all transport systems.

There are 235,538 links and 102,147 nodes in the NAVTEQ mapping of which 51,255 links and 7561 nodes make up the modelled network.

Table 4-1 Link Types

Link Type Number	Link Description	No. of Lanes	Link Capacity (v/hr)	Free Flow Speed (kph)
10	Motorway	2	4850	120
20	Dual c/w Nat Primary	2	3500	100
21	Dual c/w Nat Primary	3	5200	100
22	Dual c/w Nat Primary	3	5200	60
23	Dual c/w Nat Secondary	2	3200	90
24	Dual c/w Regional Road	2	2700	80
25	Dual c/w Nat Primary	2	3500	60

30	Single c/w Nat Primary	1	1750	80
31	Single c/w Nat Secondary	1	1600	75
32	Single c/w Regional Road	1	1350	70
40	Motorway Slip Road	1	1600	80
41	Motorway Slip Road	2	3200	80
42	Nat Primary Slip Road	1	1600	60
43	Motorway Slip Road	3	4750	60
44	Motorway Roundabout	3	5200	40
45	Nat Primary Slip Road	2	3200	60
46	Nat Primary Slip Road	3	4200	60
50	Nat Primary Urban Road	1	1600	40
51	Nat Secondary Urban Road	1	1350	40
52	Regional Road Urban Road	1	1250	40
53	Regional Road Urban Road	2	2500	40
54	Nat Primary Urban Road	2	3000	40
55	Nat Primary Urban Wide	1	1600	40
56	Regional Road Urban	3	3750	40
57	Nat Primary Urban Road	3	4200	40
60	Nat Primary Roundabout	1	1750	40
61	Nat Secondary Roundabout	1	1350	40
62	Nat Primary Roundabout	2	3500	40
63	Regional Road Roundabout	1	1250	40
64	Regional Road Roundabout	2	2500	40
65	Nat Primary Roundabout	3	4200	40
66	Nat Primary Roundabout	4	5000	40
67	Regional Road Roundabout	1	1350	40
68	Nat Primary Roundabout	1	1600	40
80	Urban Road (Local Road)	1	1000	40
81	Urban Road (Local Road)	2	2000	40
84	Roundabout Urban	1	1000	40
85	Roundabout Urban	2	2000	40
86	Roundabout Urban	3	2000	40

4.3.3. Connectors

Once the network has been coded it needs to be connected with the zoning system so the trips can be assigned onto the network. This involves a process of connecting the zones to the network at one or more locations via zone connectors. The connectors act as both the origin and destination point for each zone. Zone connectors were added automatically by VISUM, and subsequent manual adjustments were made to ensure accurate allocation of connectors, particularly for urban areas.

4.4 Network Development – Speed Flow Curves

The VISUM software has a variety of approaches that can be used for defining speed flow curves. The most commonly used appears to be the BPR (Bureau of Public Roads) approach which adopts an equation of the following form:

$$t_{cur} = t_0 * [1 + [a * sat^b]]$$

Where
$$sat = \frac{q}{q_{\max} * c}$$

q = flow and a, b and c are user defined parameters.

The BPR function was used as the staring point for assessing the speed flow relationship in the model. The BPR function works well once the link capacity does not reach its saturation point. Initial reviews of the model showed that although several links where over capacity the speed on the link was not reducing.

As such, it was decided to use another function to define the speed flow curves. The BPR3 function was used which is derived from the original BPR function but takes into account the reduction in speed on an over capacity link. The function is defined as follows:

$$t_{cur} = t_0 * \left[1 + \left[a * sat^b\right]\right] + (q - q\max) * d$$

Where
$$sat = \frac{q}{q_{\max} * c}$$

q = flow and a, b, c and d are user defined parameters.

The BPR3 function was used to develop volume-delay functions for the following road types:

Motorway;
Dual Carriageways;
National Primary Roads;
National Secondary Roads; and
Urban Roads

Speed-Flow curves showing the BPR3 function for each of the above road types is contained in Appendix B.

4.5 Network Checking

A process of reviewing the network was undertaken to check for any errors which may have occurred during the initial network coding. The following key checks were undertaken as part of the review:

Zone Connectors and Closed Links;
Link Capacity; and
Routing of Traffic.

4.5.1 Zone Connectors and Closed Links

Once the network had been coded and zones connected to the network a unity matrix was created and assigned to the network. This allowed traffic to be assigned to the network and identified any zones which were not adequately connected to the network. It also highlighted any links that are closed to traffic as the model will not assign the unity matrix if a zone is unconnected or the path between two zones cannot be found.

4.5.2 Link Capacity

Once a full base year matrix had been developed and assigned to the network the capacity of links in the network could be checked. A graphical display of the network comparing link capacity against flow was produced which highlighted links that were over capacity. The characteristics of each link that were significantly over capacity were checked in greater detail (i.e. no. of lanes, speed flow relationship etc) to ensure that they were appropriate for that link type and changed if necessary.

4.5.3 Routing of Traffic

A process of checking the routing of traffic between origin and destinations along key routes was also undertaken to check if the model was distributing traffic in a realistic manner. Flow bundles were carried out on key links and the origin and destination of traffic on theses links was assessed. Any illogical routes were corrected by changing the location of any connectors which may have connected to the network at an incorrect location.

5.0 Trip Matrix Development

5.1 Introduction

This chapter describes the processes used to develop the base year trip matrices for the National Traffic Model. The best use has been made of observed trip data obtained from the 2007 road side interviews (RSI) and existing RSI data collected in 2006 for the development of the Leinster Model. In addition to the observed data, an element of the trip matrices has been derived synthetically, primarily to account for the fact that it was not feasible to attempt to capture all movements in the programme of RSI surveys. It has also been possible to make use of information contained in the 2006 Place of Work – Census of Anonymous Records (POWCAR) and the 2005 Leinster Orbital Route (LOR) model.

In developing the matrices, commercially available software was used. Firstly, the matrix building functions included within CUBE:TRIPS were used to generate the observed matrices; combining the data collected at each of the RSI and filtering the data to remove double counting, and compressing into the model zoning system. Following this, the synthetic elements of the matrices were generated in EMME2, using relationships derived from the observed data. In addition to these modelling packages, extensive use was made of Excel and the GIS package MapInfo.

Without an Irish national trip end model, estimating and justifying the total number of trips across the model was an issue, and this particularly impacted on calculating relatively short distance trips. The survey data used to build the matrices mainly captured strategic, longer distance, trips.

5.2 Modelled Time period

The following time periods are modelled within the National Traffic Model:

- Average hour in the morning peak between 07:00 and 09:00;
- Average hour in the inter peak period between 12:00 and 14:00.

The approach of modelling an 'average' hour is considered the most suitable for a strategic model such as the National Traffic Model. Modelling a discreet hour in such cases can lead to problems relating to the actual timing of a trip. Also, the factoring of average hour assignments to an AADT figure is more robust using this technique.

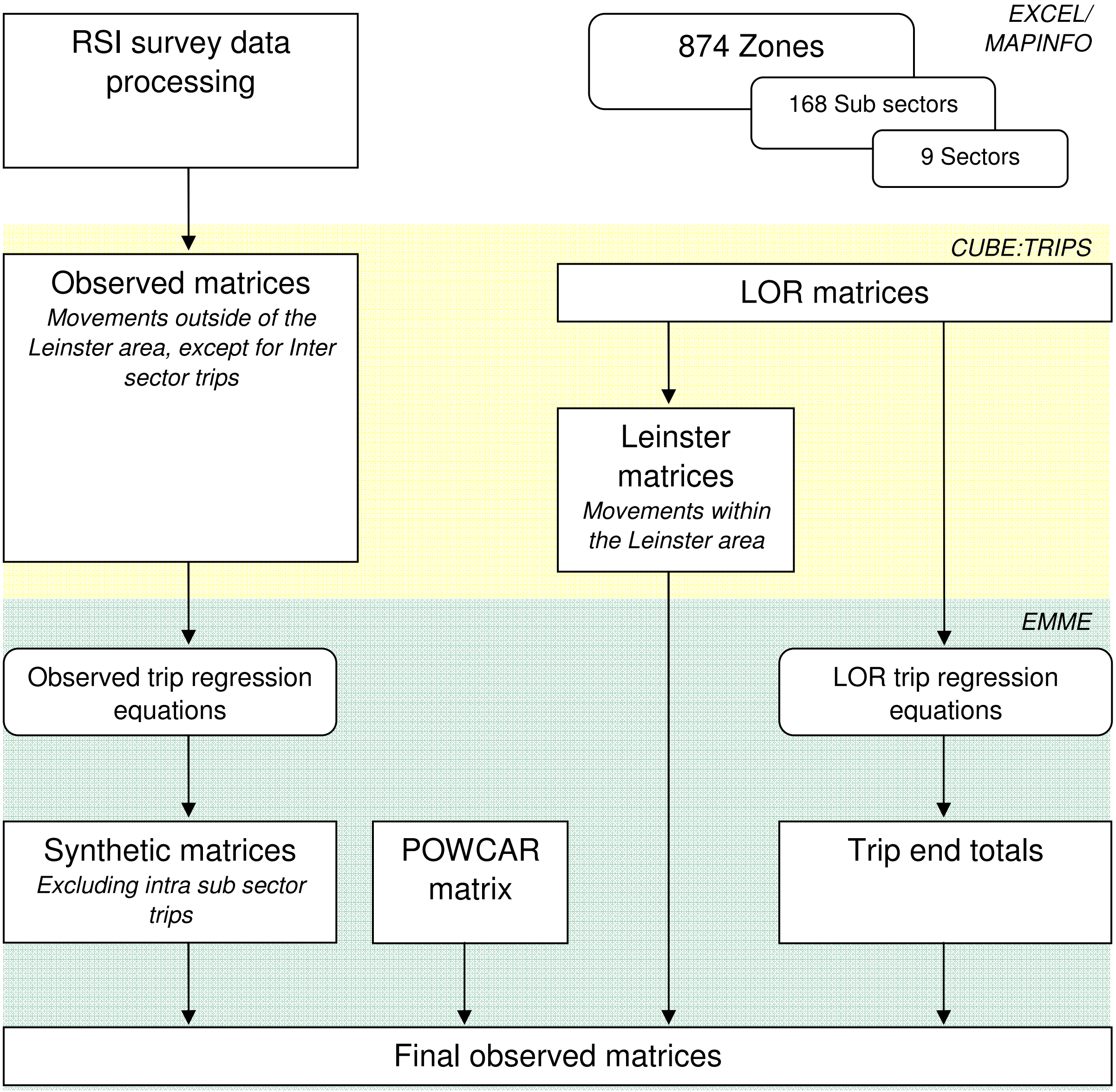
5.3 Overview of Matrix Development Process

The overall process can be described in seven distinct sub-processes as illustrated in Figure 5-1. These are as follows:

- Processing of the RSI data;
- Defining the model zone system;
- Development of observed matrices for movements outside of the Leinster area;
- Development of observed matrices for movements within the Leinster area;
- Development of a synthetic matrix;
- Creation of a trip end model; and

- Amalgamation of observed and synthetic matrices to form the final matrices for model assignment.

Figure 5-1 Matrix Building Process



5.4 Roadside Interview Data Processing

5.4.1 Overview

The RSI data collected in the 2007 surveys and for the 2006 Leinster Model was subject to a thorough review. Further detail relating to the evaluation and logic checking of the 2007 data has been provided in Chapter 2. Prior to using the data, all records were checked to ensure that they had correctly been coded to a known District Electoral Division (DED) zone and expansion factors calculated, based on observed traffic volumes to enable the creation of RSI site matrices for an average AM Peak hour and Inter Peak hour disaggregated into one of seven journey purposes

- Home Based Work (HBW);
- Home Based Employers Business (HBEB);
- Home Based Education (HBED);
- Home Based Other (HBO);
- Non Home Based Employers Business (NHBEB);
- Non Home Based Other (NHBO); and
- Freight (HGV).

5.4.2 Data from 2006 Leinster Study

In total there were 4,588 records in the Leinster RSI data, however due to the specific requirements of the Leinster model not all records had been coded with a DED zone for the trip origin and destination; rather the following zonal system had been adopted:

- Trip ends within the counties of Dublin, Wicklow, Meath and Kildare were allocated a Dublin Transport Office (DTO) model zone;
- Trip ends outside of the counties of Dublin, Wicklow, Meath and Kildare were allocated a DED zone ; and
- Trip ends within the Dublin City area were allocated a single zone (zone number 13125).

It was also observed that all origins and destinations to the west of Ireland had only been coded to county level (representing 28% of all records), although this had been undertaken at the time to facilitate subsequent expansion to DED level for the National Traffic Model. Origin and destination locations in Northern Ireland were coded at a county level. These major cities and counties were identified as follows:

- Major Cities - Galway, Limerick and Cork;
- Counties - Sligo, Mayo, Leitrim, Galway, Roscommon, Clare, Limerick, Kerry, Cork and Tipperary
- Six counties in Northern Ireland

The following was therefore required to code the Leinster records to a format which would be consistent with the National Traffic Model:

- The DTO codes needed converting to DEDs;
- The coding to county level required coding to DEDs; and
- Manual recoding of any uncoded or incorrectly coded records.

The general approach to converting a record with a DTO trip end to an equivalent DED zone was to match geographical locations using MapInfo. In some cases the DTO zones encompassed more than a single DED zone and for such occurrences a process was developed to randomly attribute the DTO zone to one of the valid DED zones taking into account population. Those DEDs with the larger population were more likely to be selected. This method was also used to allocate DEDs to records coded to the 13125 zone, which in the raw data represented the Dublin area inside the M50.

For those records coded at major county or city level, MapInfo was used to match the majority of these records to an equivalent DED. The remaining unmatched records were dealt with manually to allocate as many as possible with a DED.

5.4.3 Summary of Coding

The number of records available for use before and after the DED coding process had been completed is summarised in Table 5-1.

Table 5-1 Summary of RSI records coded to DED level

Data Source	No. of Records	Initial Status		Final Status	
		No. Usable	Proportion	No. Usable	Proportion
2006 Leinster Model	4,588	3,061	66.72%	4,573	99.67%
2007 National Model	19,800	17,300	87.37%	19,797	99.98%
Total	24,388	20,361	82.50%	24,370	99.93%

5.4.4 Expansion of Roadside Interview Data

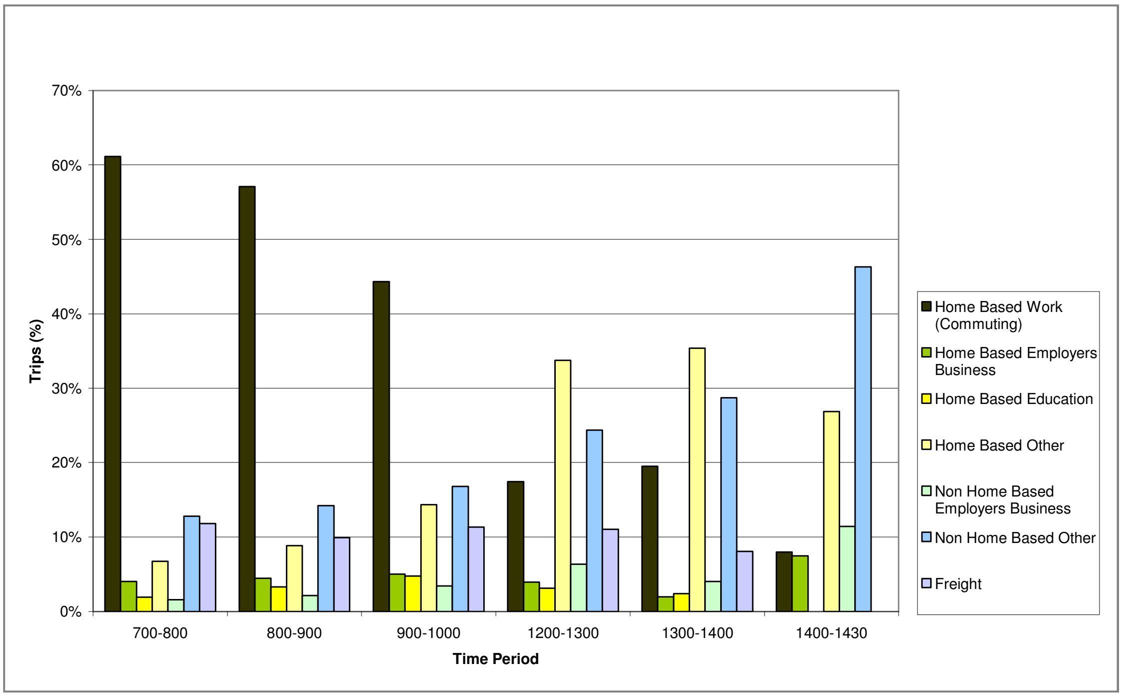
RSI and manual classified count (MCC) data were combined to factor up the RSI records to observed traffic volumes through each of the interview sites. Separate expansion factors were calculated for light vehicles (comprising of cars and LGV) and heavy vehicles (OGV1 and OGV2).

An analysis of the Leinster RSI data indicated that within each surveyed hour the journey purpose distribution was subject to quite a large degree of variation. In particular, there were noticeably fewer home based work trips between 09:00 and 10:00 periods than in the two hours preceding this. Expansion factors were therefore calculated based on the following two-hour periods for the AM Peak and Inter Peak:

- Average AM Peak hour: between 07:00 and 09:00; and
- Average Inter Peak hour: between 12:00 and 14:00.

The calculations were undertaken in a manner so that the expanded trip records were weighted in favour of the busier of the two hours. A summary of trip purposes by time period is shown below in Figure 5-2.

Figure 5-2 Journey Purpose Split Observed in 2006 Leinster RSI Data



5.4.5 Amendments to RSI Records

A number of instances arose where no RSI records existed in a given hourly time interval, or in some situations for a whole AM or IP 2 hourly time period (although the latter only occurred in the heavy vehicle data). In this situation, expansion factors were not being calculated and accompanying count data was not reflected in the matrices. The following steps were therefore taken:

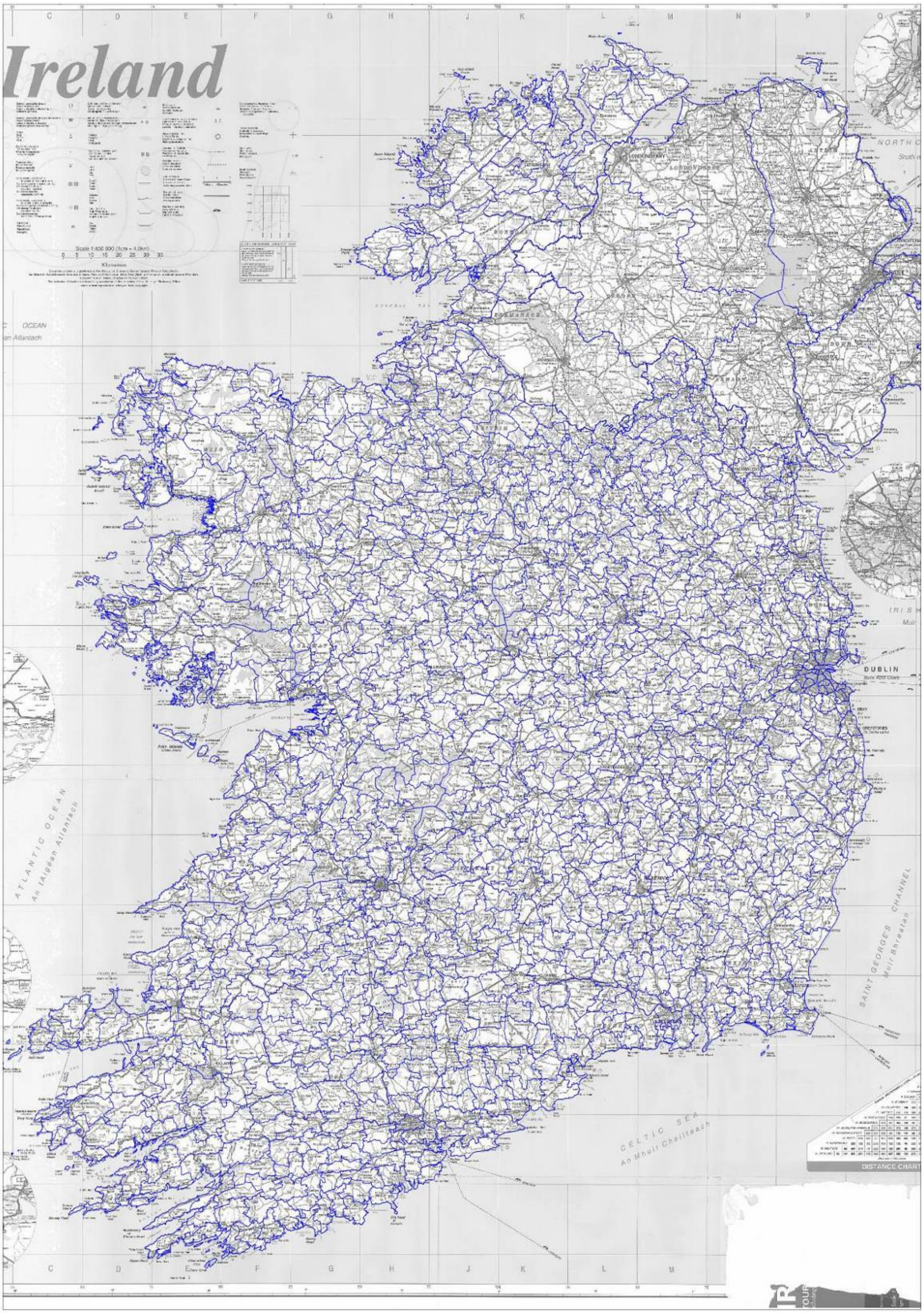
- Where RSI data only existed for one of the two hourly AM or IP time intervals, count data was combined into the one hour where RSI records exisited (required mainly for heavy vehicle data, but also for some light vehicle data);
- Where RSI data did not exist across a whole AM time interval (2 hours), data was transposed from the PM (heavy vehicle data only); and
- Where RSI data did not exist across a whole IP time interval (2 hours), data was transposed from the opposite direction (heavy vehicle data only)

5.5 The Zone System

For the purpose of developing the trip matrices from the RSI data, all trips ends in the Republic of Ireland were coded to one of 3,447 DED zones. A further six zones were used to represent the six counties within Northern Ireland. Hence, trip data was stored in a 3,453 x 3,543 sized matrix.

It was accepted that a matrix of this size would lead to extreme difficulty in calibration due to the potential for significant run times. Instead, it was decided that a reduced number of zones would be defined, with the final total being influenced by the need to model clusters of population and employment at sufficient detail, minimise the number of intrazonal trips, and maintain a reasonable run time. The final matrix size adopted for the highway assignment is an aggregation of the DED zonal system, comprising a total of 874 zones, and was ultimately determined following a series of test assignments using dummy matrices. This 874 zoning system is mapped below in Figure 5-3, with the zone boundaries defined in blue.

Figure 5-3 Zone Plan for National Traffic Model



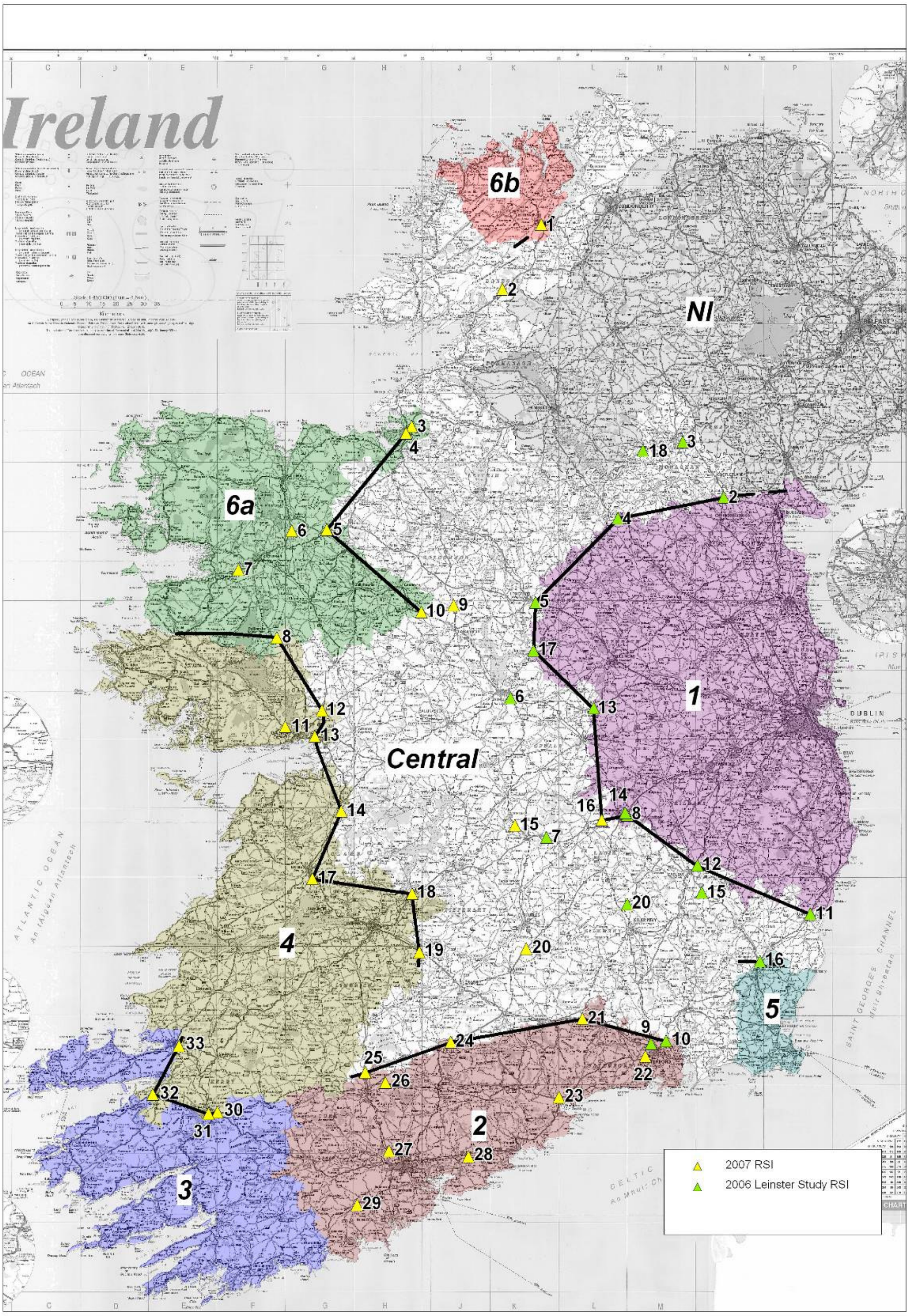
5.6 Construction of Observed Matrices (National)

The expanded site RSI matrices were combined to form a series of screenlines, designed to capture the major strategic movements between (inter) different areas (sectors) of the country. Screenlines are defined in Table 5-2 below. Figure 5-4 illustrates the location of the screenlines and the sectors together with the 2007 RSI and 2006 Leinster RSI sites.

Table 5-2 Definition of National Traffic Model Screenlines

Screenline	RSI Sites	Function
1. Leinster	L1, L2, L4, L5, L8, L11, L12, L13, L17 and N16	To capture trips from the Greater Dublin area and the rest of the country
2. South Coast	L10, N21, N24, N25,	This covers all trips leaving counties Waterford, Cork and Kerry, excluding the Killarney to Limerick area.
3. South West	N30, N31, N32, N33	This covers trips from the Killarney and Tralee area to the rest of the country.
4. Western	N11, N12, N13, N14, N17, N18, N19	Picks up all trips from the counties of Limerick, Galway and Clare.
5. South East	L16	For trips out of Co Wexford. Site L15 can give some local trips into Carlow from the south but for longer distance movements it is largely duplicated by sites L12 and L16.
6a. North West A	N3, N4, N5 and N10	For trips from Counties Sligo and Mayo.
6b. North West B	N1	For Co Donegal, although there is very poor coverage here. N1 gives trips out of Letterkenny. N2 gives trips between Letterkenny and Donegal. There is nothing for any trips out of Donegal Town unless they go through Sligo.

Figure 4.4 – Screenlines and Sectors



An exercise was then carried out to qualify the degree of confidence that could be placed in the ability of the screenlines to capture traffic movements between the different sectors. This was done by considering sector to sector movements and noting the position of the RSI sites in relation to the strategic road network.

Table 5-4 summarises the level of coverage of observed movements between sectors, where the degree of coverage is described as:

- Poor - little or no movements between sectors are observed in the screenlines;
- Moderate - implies the majority of movements between sectors are likely to have been observed, although not sufficiently enough to be judged as fully observed; and
- Good – the vast majority of movements between these sectors will have been fully observed.

Table 5-4 Observed Data Coverage

	Leinster	South	South West	West	North West A	North West B	Central	South East	N Ireland
Leinster		Good	Good	Good	Good	Good	Moderate	Good	Poor
South	Good		Poor	Moderate	Good	Good	Moderate	Good	Good
South West	Good	Poor		Moderate	Good	Good	Moderate	Good	Good
West	Good	Moderate	Moderate		Moderate	Good	Moderate	Good	Moderate
North West A	Good	Good	Good	Moderate		Good	Moderate	Good	Moderate
North West B	Good	Good	Good	Good	Good		Moderate	Good	Moderate
Central	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate		Moderate	Poor
South East	Good	Good	Good	Good	Good	Good	Moderate		Good
N Ireland	Poor	Good	Good	Moderate	Moderate	Moderate	Poor	Good	

Individual screenline matrices were created by combining all the applicable expanded RSI site matrices. An overall observed inter-sector matrix, for each time period and split by journey purpose was then derived by adding together the individual screenline matrices.

It was possible for a trip to be captured on more than one occasion, i.e. by passing through two or more RSI sites. It was therefore necessary to remove all multiple counted trips from the combined screenline matrix - the process is described in more detail in Appendix C

5.7 Construction of Observed Matrices (Leinster)

For trips wholly within the Leinster screenline (defined as Leinster intra-sector) use was made of the matrices previously developed for the Leinster Orbital Route (LOR) highway model.

- LOR AM (08:00-09:00) and IP (average hour between 10:00 and 16:00) light and heavy vehicle matrices converted from passenger car units (PCU) to vehicle equivalent (Light vehicle = 1PCU, Heavy vehicle = 2PCU);
- Trip end in LOR matrix attributed to an equivalent DED. Where a single LOR zone equated to more than one DED zone, a random process was used to allocate the zone weighted in favour of those zones with the largest population;
- Trips with a trip end external to the Leinster area discarded;
- AM Peak Hour matrix factored by 0.92 to represent average 07:00-09:00 value; and
- IP matrix factored by 0.93 to covert to average 12:00-14:00 value; and
- Light vehicle matrix disaggregated into six journey purposes based on proportions observed in the Leinster RSI data, shown in Table 5-5 below.

Table 5-5 Leinster Intra Sector Journey Purpose Proportions (Light Vehicles)

	HBW	HBEB	HBED	HBO	NHBEB	NHBO
AM*	66.0%	4.7%	3.1%	8.9%	2.2%	15.1%
IP**	20.2%	3.1%	3.1%	38.5%	5.8%	29.2%

Note: These proportions were taken from the 07:00 – 09:00 period for the AM and the 12:00 – 14:00 period for the IP.

5.8 Development of Synthetic Matrices

5.8.1 Requirement for Synthetic Matrices

The production of the observed trip matrices from the RSI surveys, detailed above, does not provide trip matrices that can be assigned immediately by the model. This is due to two limitations inherent in all RSI surveys:

- Only trips travelling between sectors are surveyed and sampled, so there is little or no information available on trips which start and end in the same sector. These trips need to be estimated and infilled; and

- RSI surveys only sample a limited number of the trips. The characteristics of these surveyed trips, including the origin and destination zones, are then expanded to represent all of the vehicles which passed that site. This expansion results in a "lumpy" matrix, with multiple trips between the observed origin-destination pairs, but no trips to or from the zones around them. Smoothing the observed trip matrix redistributes these expanded observed trips across zones near the origin and destination of the trips.

For both these reasons, the expanded observed trip matrices only provide the basis for the final trip matrices, with further processing required. A summary of the steps in this multi-stage process is given below:

- Calculate trips (by trip purpose and time period) between 168 sub-sectors (created by zonal aggregation);
- Spread estimated trips between sub-sectors across the zones in the origin and destination sub-sectors;
- Calculate trips between zones in each sub-sector;
- Spread estimated trips between zones within each sub-sector;
- Replace estimated trips within LOR internal model area with LOR trips; and
- Combine trips into assignment classes (HBW, Light vehicles and Heavy Goods Vehicles in AM, Light vehicles and Heavy Goods Vehicles in IP).

5.8.2 Trips between Sub-Sectors

Given the low sampling rate at some of the RSI survey sites, and the correspondingly small number of observed trips, it was not possible to calibrate direct demand (regression) equations to estimate trips based on the demographic characteristics of origin and destination zones.

To proceed, it was necessary to aggregate the 874 zones into 168 sub-sectors. This aggregation process took into account the screenline sectors, location of major settlements, the representation provided by the model network and the location of the traffic count sites that would be used in the model calibration. The definition of the sub-sectors is provided in Appendix C.

After defining the sub-sectors, all of the trip and demographic information for the zones in each sub-sector was aggregated. This information included the skimmed travel times, where it was necessary to use the weighted average journey time between sub sectors where calculated. The weighting was based on zonal population, so the travel times from a zone with a relatively large population within a sub-sector would have a greater weighting than that of a zone with a relatively small population.

Regression analysis was then undertaken to derive the direct demand equations that would be used to estimate trips between sub-sectors for each of the trip purposes. The analysis used the combined trips from both the AM and IP periods. This analysis related the expanded number of observed trips between sub-sectors to the following demographic data for the origin and destination zones:

- Population – school age, working age or adult, depending on trip purpose;
- Car available population – working age or adult, depending on trip purpose;
- Households; and
- Employment – either total or broken down into eight industry categories.

The resulting direct demand equations are shown in Table 5-6.

Table 5-6 Direct Demand Equations for Trips between Sub-sectors

Trip Purpose	Adjusted r^2	Direct Demand Equations (Trips between Sub-sectors)
Home Based Work	0.58	[283.9 × (Origin Working Popn × Dest Employment) × $Time^{-2.4794}$] / 100,000
Home Based Employers Business	0.50	[4.9395 × (Origin Working Popn × Dest Employment) × $Time^{-1.7873}$] / 100,000
Home Based Education	0.38	[1.092 × (Origin School Popn × Dest Popn) × $Time^{-1.454}$] / 100,000
Home Based Other	0.56	[2.6109 × (Origin Adult Popn × Dest Popn) × $Time^{-1.7546}$] / 100,000
Non-Home Based Employers Business	0.52	[212.16 × (Origin Employment × Dest Employment) × $Time^{-2.3507}$] / 100,000
Non-Home Based Other	0.52	[0.823 × ((Origin Popn + Origin Employment) × (Dest Popn + Dest Employment) × $Time^{-1.7623}$] / 100,000
HGV	0.43	[0.4584 × ((Origin Popn + Origin Employment) × (Dest Popn + Dest Employment) × $Time^{-1.7547}$] / 100,000

The adjusted r^2 values range between 0.38 and 0.58 for all trip purposes except HGV, which indicate an acceptable fit for a strategic model. The lower adjusted R^2 value for Home Based Education trips indicates that the number and pattern of these trips is dependent upon other factors than just the limited demographic data used here and/or that the majority of these trips are generally short distance local trips, so unlikely to be sampled by the inter-urban RSI sites used for this strategic model, leading to the low sampling rates experienced.

Graphs showing the fit of these equations to the observed data for each trip purpose are provided in Appendix C.

Following generation of the estimated number of trips between sub-sectors, these were split between the AM and IP time periods. This split was based on the proportion of the total expanded observed vehicles in each of the time periods for each of the seven trip purposes, and the factors used are shown in Table 5-7.

Table 5-7 Proportion of Trips in Each Time Period

Trip Purpose	AM Factor	IP Factor
Home Based Work	0.796	0.204
Home Based Employer's Business	0.609	0.391
Home Based Education	0.557	0.443
Home Based Other	0.222	0.778
Non-Home Based Employer's Business	0.343	0.657
Non-Home Based Other	0.314	0.686
HGV	0.480	0.520

The expanded observed trips between sub-sectors in different cordoned sectors for which travel between them had been fully observed (shown as 'Good' in Table 4.3) were then used to replace the estimated trips between these sub-sectors for each trip purpose and time period. This ensured that the data collected from the RSI surveys was fully utilised. In addition, the smoothing of trips between sub-sectors reported in the next paragraph solved the issue of 'lumpiness' associated with the expansion of RSI survey data. This was also done for the expanded observed trips to and from Northern Ireland, as the coarse nature of the zoning system in Northern Ireland does not permit the estimation of the trips using the direct demand equations – the zonal demographic data is outside the range for which they were calibrated.

The trips were then smoothed (for each trip purpose and time period) to allocate the trips estimated between the sub-sectors to trips between individual zones in the origin and destination sub-sectors. The total trips between sub-sectors were smoothed using weighted demographic data and travel times for the zones between each sub-sector. For example, a zone with a large population would take a greater share of the trips between sub-sectors than a zone with a small population, and similar zones close to each other would have more trips than ones further apart.

5.8.3 Trips within Sub-Sectors

After estimating the trips between sub-sectors and smoothing them across the zones in the origin and destination sub-sectors, the next stage was to estimate the number and pattern of trips between zones in the same sub-sector. As the sub-sectors had been defined so that they were all within only one of the cordoned sectors, there was no observed data from the RSI surveys that could be used to estimate their internal trips. It was therefore necessary to estimate the total number of trips starting and ending in each zone and, using the number of trips already estimated between sub-sectors, calculate the remaining number of within-sub-sector trips.

To calculate the number of trips starting and ending in each zone (the origin and destination trip ends for each zone), a regression analysis was undertaken using the LOR trip matrices and the underlying demographic data for the NHM zones covered by the LOR model area. In order to provide as robust an estimate as possible, the trip end models calculated light vehicles and HGVs only, and combined the trips from the AM and IP periods.

The resulting regression equations for these trip end models are shown in Table 5.8, with graphs showing the LOR trip ends against estimated trip ends in Appendix C.

Table 5-8 Trip End Models

Vehicle Type	Trip End	Adjusted R^2	Regression Equations (Zonal Trip Ends)
Light Vehicles	Origins	0.92	0 + (0.276336 × Car Available Adults) + (0.055480 × Employment)
	Destinations	0.90	0 + (0.251914 × Car Available Adults) + (0.134087 × Employment)
HGV	Origins	0.71	0 + (0.013359 × Households) + (0.079082 × Construction Employment) + (0.016920 × Commerce Employment)
	Destinations	0.68	0+ (0.005395 × Population) + (0.006463 × Employment)

As can be seen, the light vehicles have very high adjusted R^2 values (around 0.90), indicating that the variables used in the regression equations explain most of the variation in trips coming from or going to the zones within the DOOR model area. The adjusted R^2 values for HGV's are lower (between 0.68 and 0.71), indicating that the fit is not as good as for the light vehicles, but are still acceptable for a strategic model. It also shows again that the number of HGV trips is dependent upon factors other than the limited demographic data used here.

After estimating the number of trip ends from and to each zone, the number of trips from those zones to zones in other sub-sectors was calculated. The difference between these, if positive, was the number of trips still to be allocated for trips to or from zones within the same sub-sector. If the number of trips to zones in other sub-sectors was more than the estimated trip ends, then there were no trips to or from that zone within the same sub-sector.

The remaining light vehicle trip ends (for trips within the same sub-sector) were then split into the six trip purposes and two time periods. The HGV trip ends were also split into the two time periods. The factors used were calculated from the combined AM and IP observed expanded trips, and are shown in Table 5-9.

Table 5-9 Proportion of Trip Ends in Each Time Period

Vehicle Type	Trip Purpose	AM Factor	IP Factor
Light Vehicles	Home Based Work	0.34	0.09
	Home Based Employer's Business	0.03	0.02
	Home Based Education	0.02	0.02
	Home Based Other	0.05	0.19
	Non-Home Based Employer's Business	0.04	0.08
	Non-Home Based Other	0.04	0.08
	Total	**1.000**	
HGV	HGV	0.48	0.52

For the zones which had trips to be allocated, they were distributed to the other zones in the sub-sector, with the trips in each sub-sector then being furnessed (balanced). Distribution was undertaken using the same methodology as used from spreading trips across the zones between sub-sectors.

5.8.4 Production of Final Matrices

Prior to the completion of the final matrices, two further steps were undertaken:

- Replace all trips internal to the LOR model area with the trips from the LOR matrices; and
- Replace the AM HBW trip matrix with commuting trips recorded by the 2006 Census (Place of Work – Census of Anonymous Records (POWCAR) dataset).

The first of these steps, replacing the estimated trips entirely internal to LOR model area, is intended to better represent the trips in and around Dublin. As this area is entirely internal to the Leinster sector, the RSI surveys provided no information on these trips. Consequently, the trips from the LOR model, which utilised RSI surveys within this area, will provide a better estimate of trips entirely within this important area.

The second step, replacing the AM HBW trip matrix entirely with a matrix of the commuting trips (departing between 07:00 and 09:00) recorded by POWCAR, is intended to better represent the important morning commuting trips. As the POWCAR dataset was collected as part of the 2006 Census, it includes the commuting patterns of every person present in Ireland on Census night (rather than estimating these based on a limited sample collected at the RSI survey sites).

Prior to being used, the POWCAR trips were reduced by 10% to reflect the number of people who travel to work on a typical weekday (as it includes commuting trips over the entire week), and then by a further 15% to reflect typical attendance rates (to account for people being on leave, sick, working at home, etc). The net result of this was to reduce the number of trips in the POWCAR dataset by 23.5%.

Finally, as POWCAR only recorded the number of trips from Home to Work, it was necessary to estimate and add in the trips in the reverse direction (Work to Home) in the morning. Analysis of the Leinster RSI data showed that Home Based Work trips in the AM period were 96.0% Home to Work and 4.0% Work to Home. Using this, 4.2% of the transposed POWCAR matrix was added to itself, with the resulting matrix representing all Home Based Work trips made by car in the AM period.

Table 5-10 shows the total number of vehicle trips for each of the eight trip purposes in the two time periods.

Table 5-10 AM and IP Trip Totals

	Total Vehicle Trips	
Trip Purpose	**AM Period**	**IP Period**
Home Based Work	331,871	86,653
Home Based Employer's Business	30,179	18,240
Home Based Education	21,337	16,912
Home Based Other	48,818	167,536
Non-Home Based Employer's Business	34,060	65,507
Non-Home Based Other	51,232	92,350
HGV	25,372	25,532
Total	**542,868**	**467,731**

Finally, individual trip matrices were combined together to produce the matrices used in the model assignment, as indicated in Table 5-11.

Table 5-11 Composition of Final Assignment Matrices

	Assignment Matrix	
Trip Purpose	**AM Period**	**IP Period**
Home Based Work	POWCAR	Light Vehicles
Home Based Employer's Business	Light Vehicles	
Home Based Education		
Home Based Other		
Non-Home Based Employer's Business		
Non-Home Based Other		
HGV	HGV	HGV

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6.0 Model Calibration

6.1 Overview

The purpose of model calibration is to ensure that the model assignments reflect the existing travel situation. Calibration is an iterative process, whereby the model is continually revised to ensure that the most accurate replications of the base year conditions are represented. The main emphasis of the calibration process is to ensure that in the AM and Inter Peak periods:

- Network coding reflects the observed base year highway network conditions therefore generating accurate traffic patterns and consequently influencing route choice;
- Traffic patterns throughout the model are accurately reflected, including the route choices selected; and
- Traffic volumes on both main roads and alternative routes are modelled accurately.

6.2 Traffic Data Used in the Calibration Process

The traffic data for the calibration process was derived from a number of sources, including;

- NRA ATC's 2005 and 2006 counts;
- Leinster Study ATC's 2005; and
- RSI ATCs 2007 (AM Peak only).

An investigation showed that no consistent traffic growth statistics could be derived for the varying counts across the years. Therefore the decision was made that the traffic data would not to be manipulated to reflect one universal base year. The base year of the model is 2006 and the counts in the calibration process were considered reflective of this base year. In order to facilitate the future year trip forecast process, and to allow the model matrices to be estimated, the traffic count data was divided in three categories:

- Light vehicles;
- Heavy vehicles; and
- Total traffic.

This subdivision of the total traffic volume into two classes provides an added level of realism to the model. It also provides greater flexibility and accuracy during the calibration process to ensure the final vehicle composition of a link flow is representative in the base year.

6.3 Scope of Calibration

The following calibration checks were undertaken for each model period, using the previously identified elements of the survey database:

- Network coding checks - Assignment of the fully-observed matrix to the base models provided a comprehensive check of the network. This enabled the coding of the junctions to be verified and also highlighted any program error files which needed to be addressed. Any errors identified during this process were corrected;

- Route Choice calibration – In order to demonstrate the model accurately reflected realistic route choice throughout the model, a significant number of investigations were made of routing for zone to zone movements. This also included reviewing the count data to ensure that observed link flows were being accurately modelled.

- Traffic Flow Calibration – Two important measures of calibration are described in the UK DRMB Volume 12a ***Section 4.4.42***, namely calibration of Link Flows, and Calibration of Screenlines.

6.4 Matrix Estimation

6.4.1 Overview

The model calibration involved several stages of targeted matrix estimation. This process is designed to automatically manipulate the origin and destination matrices to match a counted volume along a particular link or multiple links. The National Traffic Model contains two user class matrices; therefore it was necessary to disaggregate the total traffic count volumes to reflect this i.e. light and heavy vehicles. The matrix estimation process was undertaken on the AM and Inter Peak separately.

6.4.2 AM Peak Matrix Estimation

The AM Peak model travel demand is composed of three trip purposes and consequently matrices. These include:

- Car Commute derived from the POWCAR surveys that were undertaken,;
- Car Other – assumed as all other trip purposes, including leisure, business, education and other trips; and
- Heavy Goods Vehicles (HGV's).

The HGV volume can be estimated using the corresponding count data; however the count data does not represent the two light vehicle trip purposes. A strategy was therefore developed to establish a purpose split as follows:

Stage 1 Estimate the individual car purposes against their observed proportions at the 60 RSI count sites undertaken for the matrix development. This ensures that a representative balance between the two purposes at the observed locations can be applied across the model area. Matrix estimation is then conducted on a proportion of the observed light vehicles based on the balance of trip purposes identified at the RSI locations. This generates a 70% / 30% split in favour of Home Based Work (HBW) as the dominant proportion.

Stage 2 For the AM Peak Matrix, estimate each matrix individually against the defined observed model screenlines. This ensures the correct volumes of traffic are captured travelling throughout the country at key strategic locations.

Stage 3 For the AM Peak Matrix, estimate the remaining counts that have not been matched.

It is noted that throughout the estimation process comparisons were made to the original RSI assessment to ensure a correlation was maintained with the original proportional split for light vehicles.

6.4.3 Inter Peak Matrix Estimation

The Inter Peak model travel demand consists of two trip purposes and therefore matrices. These include;

- Light (Cars) – no POWCAR survey information was available for this time period so all light vehicles were treated as the same; and
- Heavy vehicles.

Given that in the Inter Peak the light vehicles are not split by purpose the matrices can be estimated against the original counted volume of light vehicles. The Inter Peak estimation process follows the same process as the AM Peak, excluding Stage 1. The screenline comparison was again used as the controlling factor for the matrix estimation process.

6.5 Calibration Criteria

The UK DMRB specifies the acceptable values for modelled and observed flow comparisons and suggests how calibration should relate to the magnitude of the values being compared, and this guidance is reflected in the Transport Appraisal Guidelines. A summary of these targets is included in Table 6-1 below:

Table 6-1 Model Calibration Criteria

Criteria and Measure	**Guideline**
Assigned Hourly Flows (e.g. links or turning movements) vs. Observed Flows:	
Individual flows within 15% for flows 700 – 2700 vph Individual flows within 100 vph for flows <700 vph Individual flows within 400 vph for flows > 2700 Total screenline flows (normally >5 links to be within 5%)	> 85% of cases

Percentage differences between observed and modelled flows can prove to be misleading given the relative value of the difference. The standard method used to compare modelled values against observations on a link involves the calculation of the Geoff Havers (GEH) statistic (Chi-squared statistic), incorporating both relative and absolute errors.

The GEH statistic is a measure of comparability that takes account of not only the difference between the observed and modelled flows, but also the significance of this difference with respect to the size of the observed flow. For instance, a difference of 50% compared to an observed flow of 10 is of far less significance than a difference of 20% compared with an observed flow of 1000. The GEH statistic is calculated as follows:

$$GEH = \sqrt{\frac{(M - C)^2}{(M+C)/2}}$$

Where:

M is the modelled flow
C is the observed flow

As a rule of thumb when comparing assigned volumes with observed volumes a GEH parameter of 5 or less indicates an acceptable fit whilst a value greater than 10 requires closer attention. Guidance in the DMRB sets out the following criteria:

Table 6-2 Model Calibration Criteria

Criteria and Measures		**Guideline**
GEH statistic	Individual flows: GEH < 5	> 85% of cases
GEH statistic	Screenline totals: GEH < 4	All (or nearly all) screenlines

6.6 Calibration Results

6.6.1 Overview

The model was calibrated against the total of light and heavy flows at the count locations. This comparison was made against the link counts experienced throughout the appropriate modelled one hour period. The calibration consists of two main elements, one being a selection of 4 strategic screenlines throughout the model and the second element being comparison against the remaining 177 calibration counts.

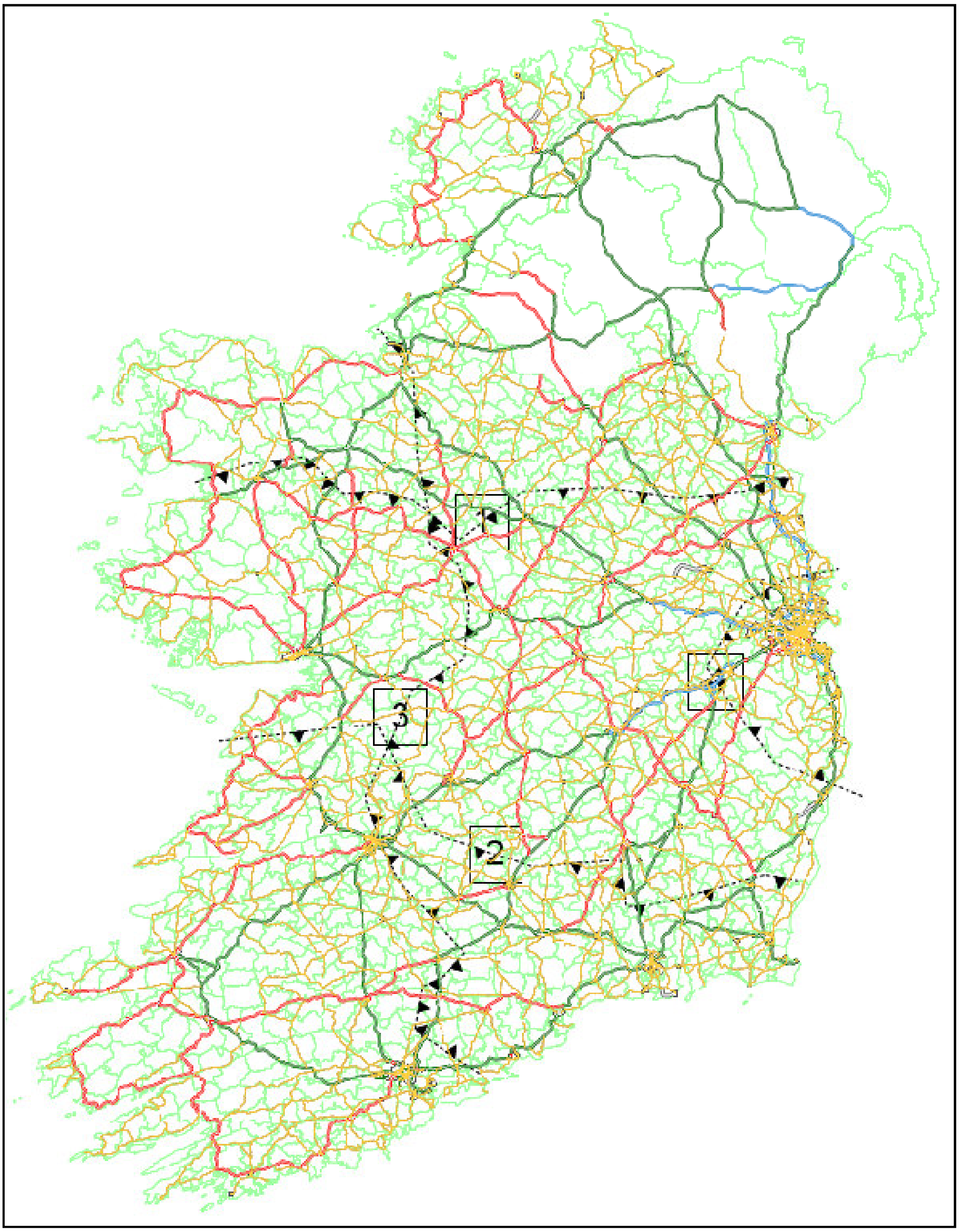
6.6.2 Comparison at Screenlines

Screenlines were selected across the model area in order to ensure the correct volume of traffic was moving strategically across the country, Figure 6-1 shows the locations of the 4 screenlines, which were selected to pass through the maximum number of count locations. Due to the number of roads crossed by the screenline and the limited data set, only those roads with count information have been evaluated. The composition of each screenline is indicated in Table 6-3.

Table 6-3 Definition of Screenlines

Screenline Number	Screenline Route	Number of Counts	Roads assessed in Screenline
1	Westport - Drogheda	24	M1,M59,N3,N4,N5,N17,N58 N59,N61,N83,R311
2	Gort - Arklow	16	N7,N8,N9,N18,N67,N76
3	Sligo - Cork	26	N4,N6,N7,N8,N25,N60,N63 N65,N72
4	Wicklow - Drogheda	12	M1,M4,M7,N2,N11,N81

Figure 6-1 National Model Calibration Screenlines



The AM Peak screenline calibration is shown in Table 6-4. The table shows that 2 out of the 4 screenlines are fully calibrated, matching the flow and GEH criteria and maintaining a screenline GEH total lower than 4. Screenlines 3 and 4 matche the flow and GEH criteria but fail to match the total GEH. Even so the detailed screenline breakdown in Appendix D shows that the difference between modelled and observed flows for individual sites is not significant.

Table 6-4 Summary of AM Peak Screenline Calibration Results

Screenline Number	Number of Counts	% of Sites with GEH < 5	% of Calibration Sites Meeting the flow criteria	Screenline Total GEH
1	22	95.45%	95.45%	3.85
2	16	100.00%	100.00%	1.84
3	26	92.31%	92.31%	6.85
4	12	91.67%	91.67%	7.31

The Inter Peak screenline calibration is shown in *Table 6-5.* The table shows that 2 out of the 4 screenlines are fully calibrated, matching all three screenline criteria. Screenline 3 matches the GEH and total GEH criteria but fails to match the flow, whereas Screenline 4 does not match the DMRB criteria. Nevertheless, the detailed screenline breakdown shows that the observed difference for individual sites is not significant. This gives confidence that model is representing a realistic situation, even though the flows are not a complete match. Appendix D contains both a model plot of the screenlines and a detailed summary table.

Table 6-5 Summary of Inter Peak Screenline Calibration Results

Screenline Number	Number of Counts	% of Sites with GEH < 5	% of Calibration Sites Meeting the flow criteria	Screenline Total GEH
1	24	91.67%	95.83%	1.87
2	16	87.50%	93.75%	1.50
3	26	88.46%	84.62%	4.03
4	12	83.33%	75.00%	11.52

6.6.3 Comparison at Count Sites

The observed flows were compared to the modelled flow for each of the calibration count in accordance with the criteria above. The permissible difference was calculated for each value (based on the observed figure) and compared with that which had been modelled. The detailed summary tables are included in Appendix D and are summarised in Table 6-6 below.

Table 6-6 Summary of Traffic Flow Calibration Results

Time Periods	% of Calibration Sites Meeting the flow criteria that: Individual Flows within 15% for flows 700 – 2700 vph Individual flows within 100 vph for flows < 700 vph Individual flows within 400 vph for flows > 2700 vph		
	Total Traffic	Lights	Heavies
AM Peak	86%	87%	99%
Inter Peak	92%	92%	99%

The comparison of modelled and observed flows identify that both the AM Peak and Inter Peak models matches the flow criteria for all user classes.

The GEH statistics for the observed and modelled flows were considered for each of the calibration counts in accordance with the above criteria. The detailed summary tables are included in Appendix D and are summarised in Table 6-7 below:

Table 6-7 Summary of Traffic Flow Calibration Results

Time Periods	% of Calibration Sites with GEH < 5		
	Total Traffic	**Lights**	**Heavies**
AM peak	85%	86%	92%
Inter Peak	90%	88%	92%

The GEH results show that the AM Peak and Inter Peak models matche the criteria well across the three trip purposes. Guidance suggests that the criteria should match total traffic volumes; therefore the fact that counts also match for light and heavy vehicles provides additional robustness. Appendix D contains model plots of the AM Peak and Inter Peak GEH count locations highlighting the quality of the count distribution.

6.7 Summary

The calibration results show that the AM Peak and Inter Peak models have been calibrated to a standard compliant with DRMB criteria. Although the Inter-peak has failed to completely match certain criteria the distribution of the matched counts throughout the model are sufficient to consider the model fit for purpose.

7.0 Model Validation

7.1 Validation Criteria

To demonstrate that the models provide a robust platform for further option development and testing, it is necessary to show that the base models accurately and realistically represent observed conditions in the base year. Following the network and matrix calibration process the calibrated model was compared against actual 2006 observed NRA ATC counts. These counts are representative of the observed model base year and have remained independent of the calibration process. The outputs from the assignments were independently compared with observed data in order to ensure that base year conditions were replicated in the modelling process. Validation checks included:

- Network validation checks (previously discussed);
- Matrix validation checks (previously discussed);
- Link flow validation and statistical criteria; and
- Overall model validation (e.g. journey time surveys).

The base year networks were independently checked to ensure that the correct characteristics had been coded for the junctions and links in the model. Particular attention was paid to the location of zone connectors to ensure that assigned trips entered and left the network at realistic locations. The model was checked to ensure that locations that were experiencing stress in the base year, due to link capacity constraints, were realistic. If these issues are not resolved in the base year the error would be factored up in future years which could influence the model forecasting and future year performance.

DMRB specifies the acceptable values for modelled and observed flow comparisons and suggests how the validation should relate to the magnitude of the values being compared. A summary is included in Table 7-1 below:

Table 7-1 Model Validation Criteria – Traffic Flows

Criteria and Measures	Guideline
Assigned Hourly Flows (e.g. links or turning movements) vs. Observed Flows:	
Individual flows within 15% for flows 700 – 2700 vph Individual flows within 100 vph for flows <700 vph Individual flows within 400 vph for flows > 2700	> 85% of cases
Total screenline flows (normally >5 links to be within 5%)	

Percentage differences between observed and modelled flows can prove to be misleading given the relative value of the difference. The standard method used to compare modelled values against observations on a link involves the calculation of the Geoff Havers (GEH) statistic, which is a form of the Chi-squared statistic, incorporating both relative and absolute errors. As a rule of thumb in comparing assigned volumes with observed volumes a GEH parameter of 5 or less indicates an acceptable fit whilst a value greater than 10 requires closer attention.

In selecting count locations for Traffic Flow Validation, DMRB states:

'the choice of links to be validated is particularly important, and these should include a reasonable selection of links that carry traffic movements critical to scheme appraisal.'

This is not, however, as applicable to a national model, where the scheme locations and size will vary significantly. Therefore, the decision was made to use the NRA ATC's for 2007 for validation. This data was representative of the base year and provided a reasonable distribution of locations across the national road network. The model count validation process involved a comparison against 60 counts, which are shown in Appendix E.

With regard to journey time validation, it is good practice to consider particular journeys through the assigned network and compare the known observed travel times with those predicted by the model. This combines the delays which are simulated at each node along the route with the link travel times and therefore presents a good indication of confidence in the model. Guidance in the DMRB sets out the following criteria shown below:

Table 7-2 Model Validation Criteria – Journey Times

Criteria and Measures	**Guideline**
Modelled journey times Compared with Observed Times:	
Times within 15% (or 1 minute if higher)	> 85% of routes

Due to the models strategic nature, 11 journey times were defined throughout the model, representing strategic movements, while attempting to remain within the limits of the 1 hour modelled time frame. The journey times were derived from an average travel time using route planning software. The decision was made that the route planning journey times into Dublin were unrealistic as they did not reflect the amount of delay experienced as one enters the City Centre area. Therefore, this has resulted in the routes focusing on locations outside of Dublin.

Table 7-3 Routes Selected for Journey Time Validation

Route Number	Route Description	Distance (km)	Speed (kph)	Time (secs)
1	Cork to Mallow	31.3	75.1	1500
2	Swords to Dundalk	69.5	94.8	2640
3	Bray to Gorey	68.3	77.3	3180
4	Letterkenny to Donegal	48.7	66.4	2640
5	Waterford to Cahir	64.3	60.3	3840
6	Kells to Blanchardstown	55	63.5	3120
7	Westport to Ballina	52.5	57.3	3300
8	Athlone to Elphin	58.8	63	3360
9	Portlaosie to Toomyvara	61.4	67	3300
10	Killarney to Mallow	66.3	65.2	3660
11	Carlow to Thomastown	40.7	61.1	2400

7.2 Validation Results

7.2.1 Overview

The validation traffic count data was subdivided into the three categories similar to the data calibration. This enabled the validation of the traffic flow vehicle composition, namely the split between the light and heavy goods vehicles.

7.2.2 Validation of Traffic Flows

The observed and modelled flows were compared at each of the validation sites in accordance with the criteria above. The permissible difference was calculated for each value (based on the observed figure) and compared with that which had been modelled. The full results are included in Appendix E and are summarised in Table 7-3 below.

Table 7-3 Summary of Traffic Flow Validation

Time Periods	% of Calibration Sites Meeting the criteria that: Individual Flows within 15% for flows 700 – 2700 vph Individual flows within 100 vph for flows < 700 vph Individual flows within 400 vph for flows > 2700 vph		
	Total Traffic	**Lights**	**Heavies**
AM Peak	88%	88%	98%
Inter Peak	97%	98%	98%

The comparison against the validation counts shows that the AM peak and Inter-peak clearly match the DRMB requirement for traffic flow at the specific count locations. The AM peak and Inter Peak match beyond the 85% guideline for all three categories. DRMB recommends that the total traffic match is above 85%, the additional matching category provides an extra level of detail to the model.

The calculated GEH statistics for the observed and modelled flows were considered at each of the validation sites in accordance with the above criteria. The full results are included in Appendix E and are summarised in Table 7-4 below.

Table 7-4 Summary of GEH Validation

Time Periods	% of Validation Sites with GEH < 5		
	Total Traffic	**Lights**	**Heavies**
AM Peak	85%	85%	92%
Inter Peak	93%	98%	92%

Similar to the flow criteria the AM Peak and Inter Peak models match the validation count GEH criteria. Both models have matched the GEH criteria at more than 85% of the count locations. The model results have clearly shown that at the validation count locations the model represents a "good fit". This indicates that the model should be 'fit for purpose' to assess the effect of highway schemes, when considered alongside the forecasting methodology. The validation count locations used for the traffic flow and GEH comparisons are consistent throughout the AM Peak and Inter Peak periods.

DMRB recommends a correlation coefficient analysis of the modelled count data in order to give some measure of the goodness of model fit against observed data. The slope of the best-fit regression line indicates the extent to which modelled values are over or under estimated. The guidance suggests that in the main area of influence of the scheme, acceptable values of the former are above 0.95 and of the latter between 0.9 and 1.10. A value of 1.0 for both statistics represents a perfect fit. However, the model is at a national scale and there are no specific schemes identified at this stage, so this level of regression is going to be very difficult to achieve across the model area. Therefore the regression analysis has been carried out across all validation counts but this might generate a misleading result due to the wide range of flows.

Table 7-5 outlines the results for the model regression analysis for the validation of total traffic counts. The table shows that both the AM and Inter Peak models represent an appropriate level of correlation between the modelled and observed data.

Table 7-5 Summary of Regression Analysis

Time Period	Y Value	R^2 Value
AM Peak	1.143	0.981
Inter Peak	1.076	0.992

7.2.3 Validation of Journey Times

The journey time comparison is required to show that the model is reflecting the actual base year network conditions, in terms of network speed, distance and delay. The model is a time based assignment only; therefore the delay is generated by the speed flow relationships assumed in the model. The model does not contain any detailed junction modelling; therefore the speed flow curves have been manipulated to reflect a level of delay given the constraints of the network. The journey time comparison is an important part of the validation process, as this indicates if the speed flow curves are performing as required and producing realistic travel times. This will in turn dictate whether the traffic routing patterns are modelled correctly.

DMRB states that the modelled journey time is required to be within 1 minute or 15% of the observed time. Tables 7-6 and 7-7 summarise the journey time results for the AM and Inter Peak models respectively. The AM Peak model matches the DMRB criteria for all 11 routes and is clearly shown to reflect realistic journey times and speeds. This indicates that the network coding is accurate and that the speed flow relationships are producing a realistic level of delay in relation to the traffic demand.

The Inter Peak model also matches well against the 11 routes, although only 10 routes match the DMRB criteria. The one route that is outside the criteria is still within an acceptable tolerance. In general, the Inter Peak model appears to be slightly faster than the observed times. In the AM Peak the level of traffic demand is higher than for the Inter Peak, and will therefore produce a higher level of delay as the average link speed reduces.

The models have therefore matched the available observed journey times suitably; however the influence of AM Peak period congestion has not necessarily been accurately reflected in specific locations. Therefore, additional journey time comparisons would be required in order to validate the model at a local level dependent on the model application.

Table 7-6 AM Peak Highway Model Journey Time Validation

Route Number	Route Description	Observed Distance (km)	Observed Speed (kph)	Observed Time (secs)	Modelled Distance (km)	Modelled Speed (kph)	Modelled Time (secs)	Does modelled route match DMRB Criteria of 15% Observed?
1	Cork to Mallow	31.3	75.1	1500	30.8	74.3	1492	YES
2	Swords to Dundalk	69.5	94.8	2640	68.9	103.1	2409	YES
3	Bray to Gorey	68.3	77.3	3180	68.7	81.9	3022	YES
4	Letterkenny to Donegal	48.7	66.4	2640	46.2	66.6	2498	YES
5	Waterford to Cahir	64.3	60.3	3840	60.2	64.1	3380	YES
6	Kells to Blanchardstown	55	63.5	3120	53.9	54.9	3539	YES
7	Westport to Ballina	52.5	57.3	3300	54.5	69.5	2848	YES
8	Athlone to Elphin	58.8	63	3360	57.4	67.9	3044	YES
9	Portlaosie to Toomyvara	61.4	67	3300	59.5	65.9	3253	YES
10	Killarney to Mallow	66.3	65.2	3660	62.2	71.8	3121	YES
11	Carlow to Thomastown	40.7	61.1	2400	40.4	68.5	2122	YES
					Percentage of routes matching DMRB Criteria			100%

Note: DMRB Target > 85% of Routes

Table 7-7 Inter Peak Highway Model Journey Time Validation

Route Number	Route Description	Observed Distance (km)	Observed Speed (kph)	Observed Time (secs)	Modelled Distance (km)	Modelled Speed (kph)	Modelled Time (secs)	Does modelled route match DMRB Criteria of 15% Observed?
1	Cork to Mallow	31.3	75.1	1500	30.8	76.6	1447	YES
2	Swords to Dundalk	69.5	94.8	2640	68.9	102.7	2418	YES
3	Bray to Gorey	68.3	77.3	3180	68.7	79.2	3127	YES
4	Letterkenny to Donegal	48.7	66.4	2640	46.2	66.1	2517	YES
5	Waterford to Cahir	64.3	60.3	3840	60.2	64.2	3376	YES
6	Kells to Blanchardstown	55	63.5	3120	53.9	64.4	3014	YES
7	Westport to Ballina	52.5	57.3	3300	54.5	70.0	2827	YES
8	Athlone to Elphin	58.8	63	3360	57.4	67.0	3089	YES
9	Portlaosie to Toomyvara	61.4	67	3300	59.5	66.6	3219	YES
10	Killarney to Mallow	66.3	65.2	3660	62.2	72.3	3097	NO
11	Carlow to Thomastown	40.7	61.1	2400	40.4	69.1	2102	YES
					Percentage of routes matching DMRB Criteria			100%

Note: DMRB Target > 85% of Routes

7.3 Network Checking

The model network was reviewed throughout the calibration and validation process in order to ensure that the base case depicted the actual current situation. The modelling methodology, including calibration, has focused on simulating current traffic patterns and traffic volumes on an accurate base year network structure. Traffic behaviour can be classed as validated as the model has matched the criteria given in current guidance for both traffic count and journey time validation/calibration.

7.4 Model Convergence

The model assignment procedure involves the model reaching a point of equilibrium through an iterative process. The model must therefore achieve a satisfactory point of convergence in order to produce results that are both reflective of the network over a number of iterations of assigning demand to the network. The convergence indicators vary by different transport modelling packages; therefore multiple criteria are outlined in the DMRB. The DMRB criteria that is used to show that the VISUM software reaches a level of convergence is the percentage of links with a flow change <5% across 4 consecutive iterations greater than 90%. The model software produces the convergence information by user class, defining the percentage difference in link volume per vehicle class.

Table 7-8 below indicates that the AM Peak and Inter Peak models both reached a satisfactory level of convergence.

Table 7-8 Model Convergence

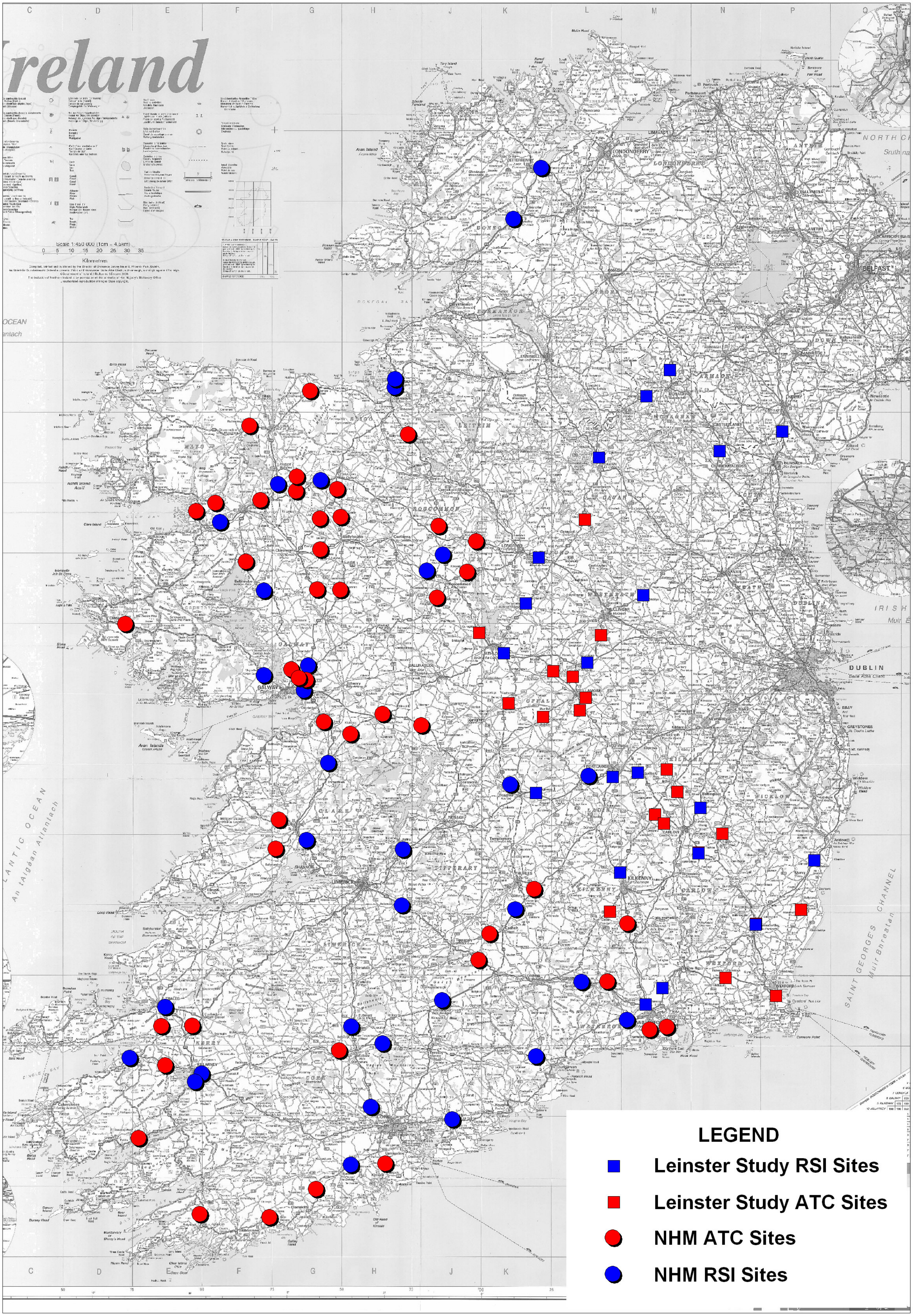
Time Period	Number of Iterations	Measure of Convergence (Percentage of links with flow change (P) <5%			
		Final Convergence Lights (POWCAR)	Final Convergence Lights (Cars)	Final Convergence Heavies	Number of Iterations > 90%
AM Peak	8	98.5%	98.4%	97.4%	7
Inter Peak	13	N/A	99.5%	99.4%	12

7.5 Conclusions

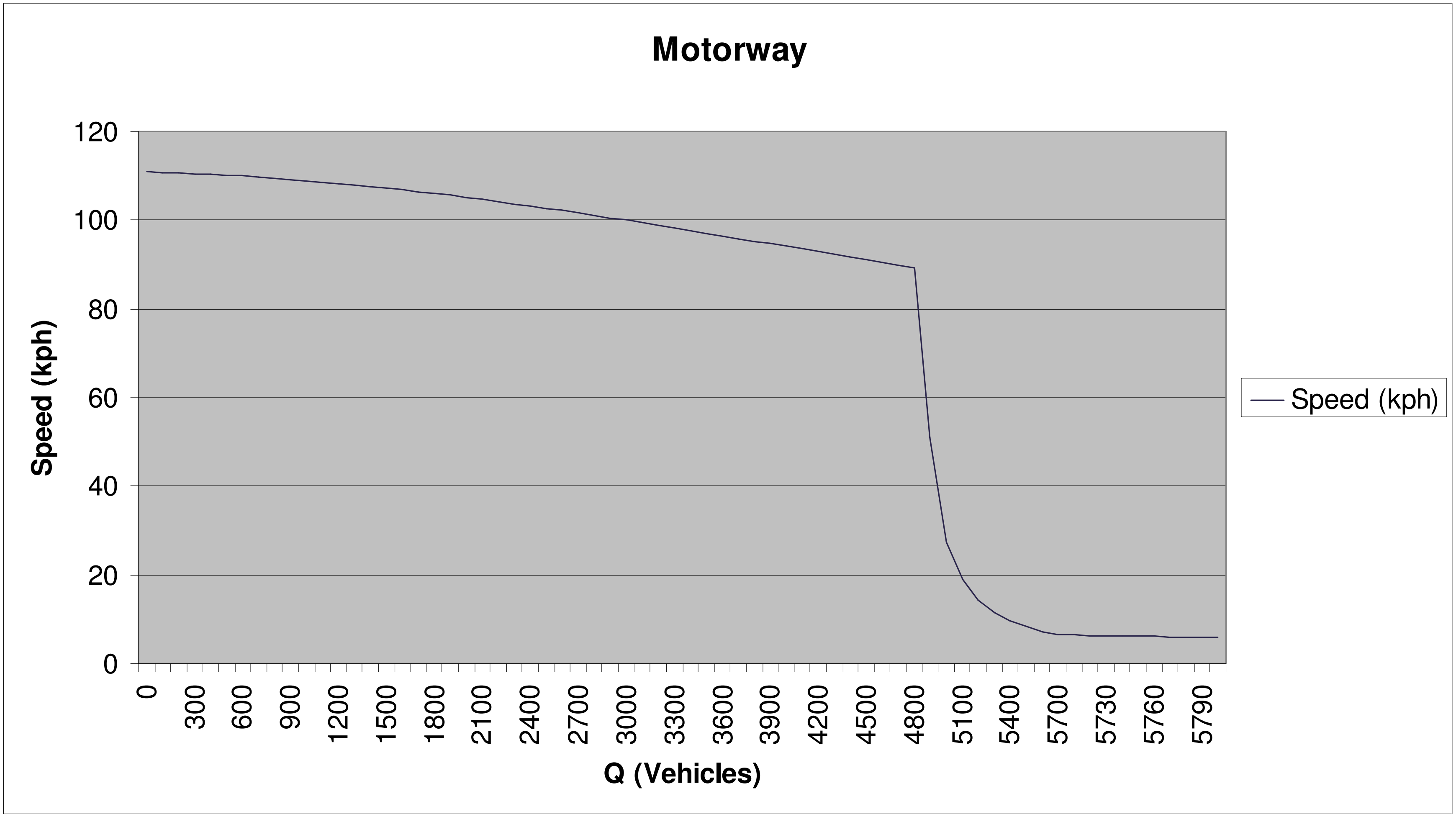
The data presented above illustrates that the National Ireland models validate well in all modelled periods. The models therefore provide a sound platform from which to develop future year option testing scenarios for the National road network. However, the model has been calibrated and validated at a strategic level only and therefore the model may not reflect accurately the situation at local level. Therefore, the model would require re-calibrating and re-validating in order to simulate traffic responses at a local scale if a cordon of the model was extracted.

Appendix A

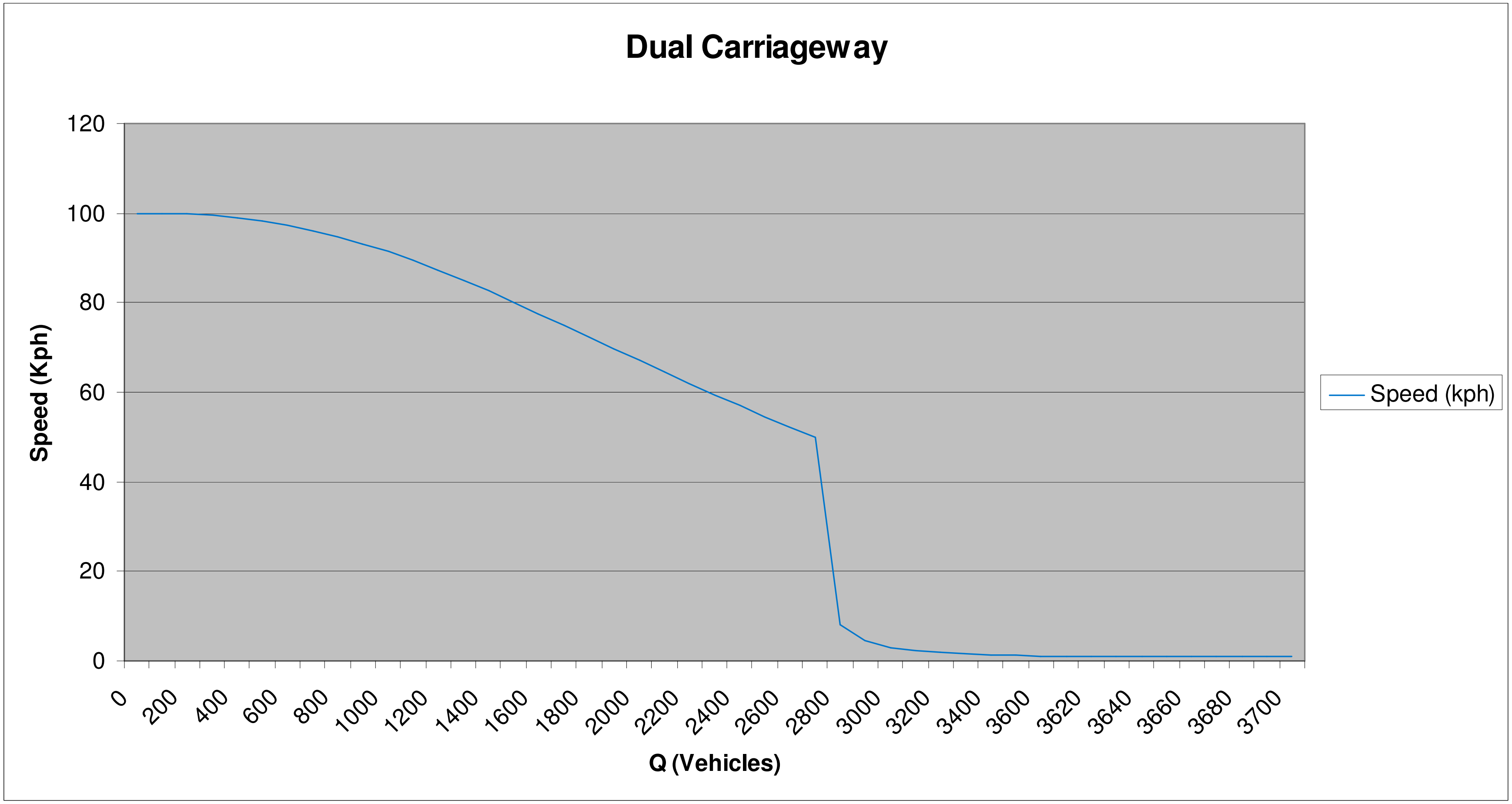
Survey Location Map


Ireland
LEGEND
Leinster Study RSI Sites
Leinster Study ATC Sites
NHM ATC Sites
NHM RSI Sites

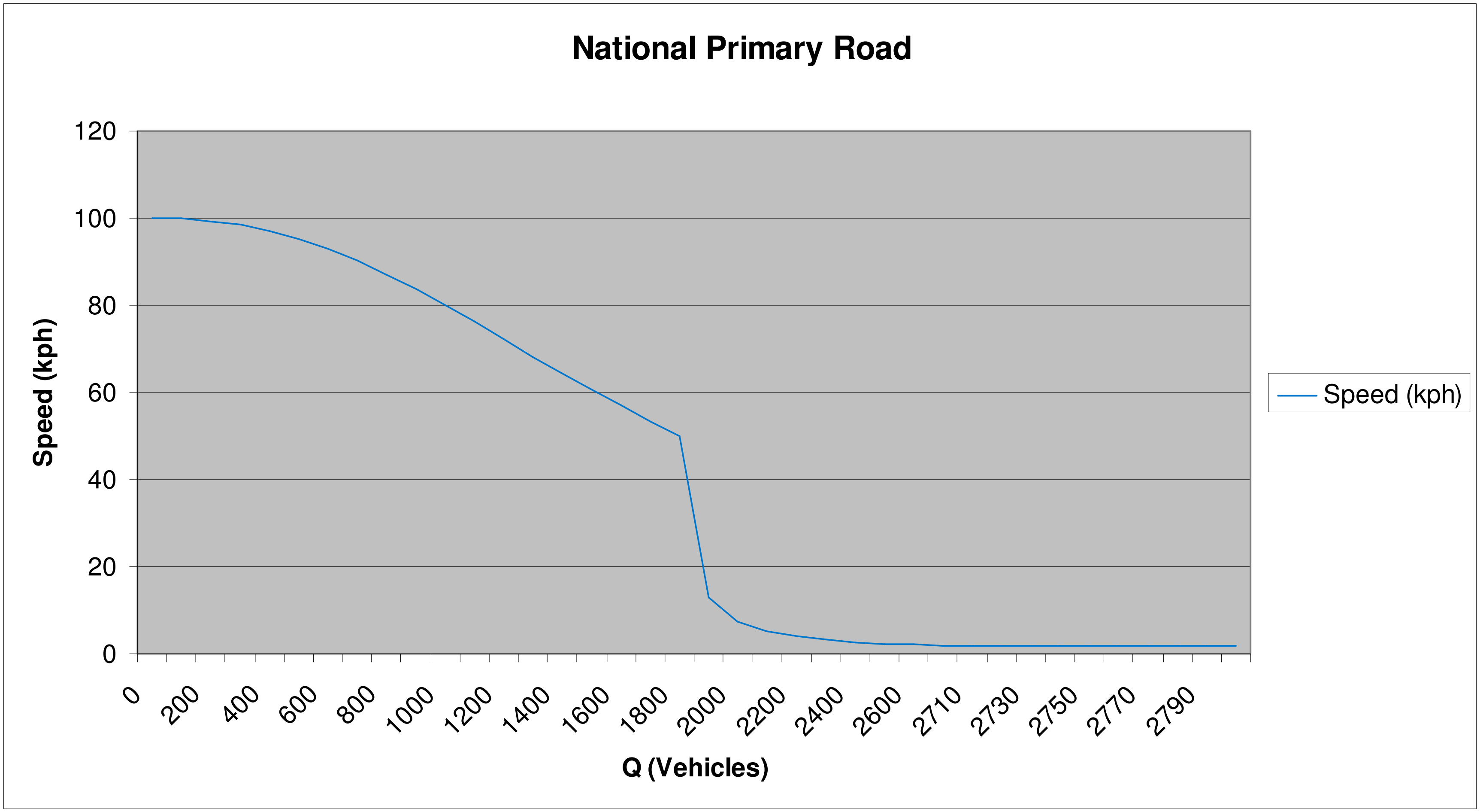
Appendix B
Speed Flow Curves



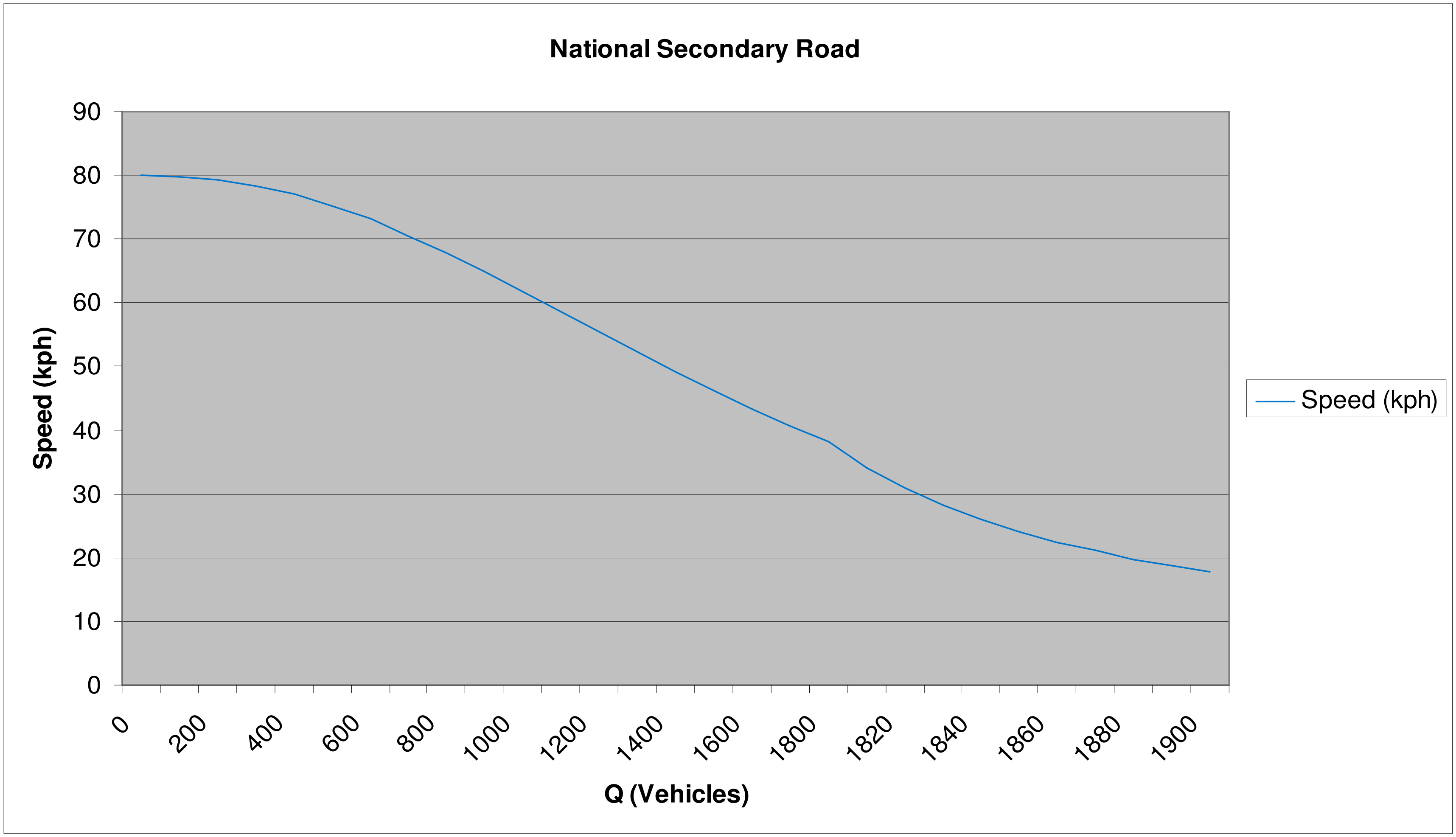
Motorway Speed-Flow Curve (BRP3)



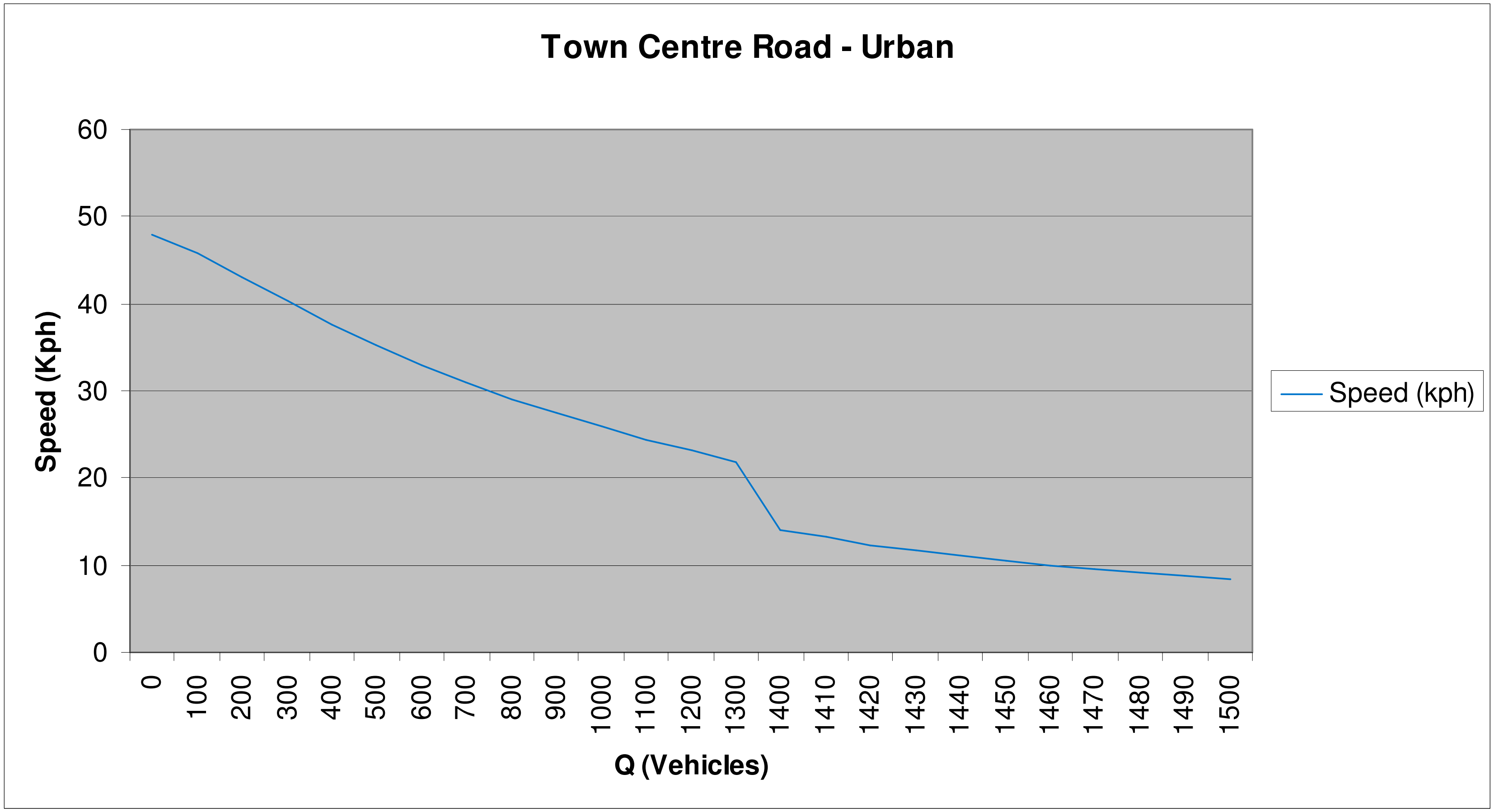
Dual Carriageway Speed-Flow Curve (BRP3)



National Primary Speed-Flow Curve (BRP3)



National Secondary Speed-Flow Curve (BRP3)



Town Centre Speed-Flow Curve (BRP3)

Appendix C
Matrix Development

Project:	**National Traffic Model**	Job No:	**Matrix Development**
Subject:	**Appendix C**	Date:	**25 Feb 2009**

1.0 Treatment of Double Counting

Due to the location of the screenlines it was possible for a trip to be captured on more than one occasion, i.e. by passing through two or more RSI sites. It was therefore necessary to remove all multiple counted trips from the combined screenline.

1.1 Inter Sector Double Counting

Table 1.1 below highlights those inter-sector movements where trips are expected to be captured more than once. All trips in the combined screenline matrix were thus divided by the appropriate value – for example those trips between the Leinster and South Coast sectors were halved to account for the fact that these trips would be observed twice.

Table 1.1 – Inter-Sector Double Counting Matrix

From/to	1. Leinster	2. South Coast	3. South West	4.Western	5. South East	6a. North West A	6b.North West B
1.Leinster		2	3	2	2	2	2
2.South Coast	2		(ii)	2	1	2 (partially)*	(i)
3.South West	3	(ii)		1	1	2	(i)
4.Western	2	2 (partially)*	1		2	1	(i)
5.South East	2	1	1	1		(i)	(i)
6a.North West A	2	1	2	1	(ii)		2
6b. North West B	2	(i)	(i)	(i)	(i)	2	

(i) - trip distance considered to be too far for double counting to be a significant issue.
(ii) - not captured in any screenline.
* - only certain elements double counted.

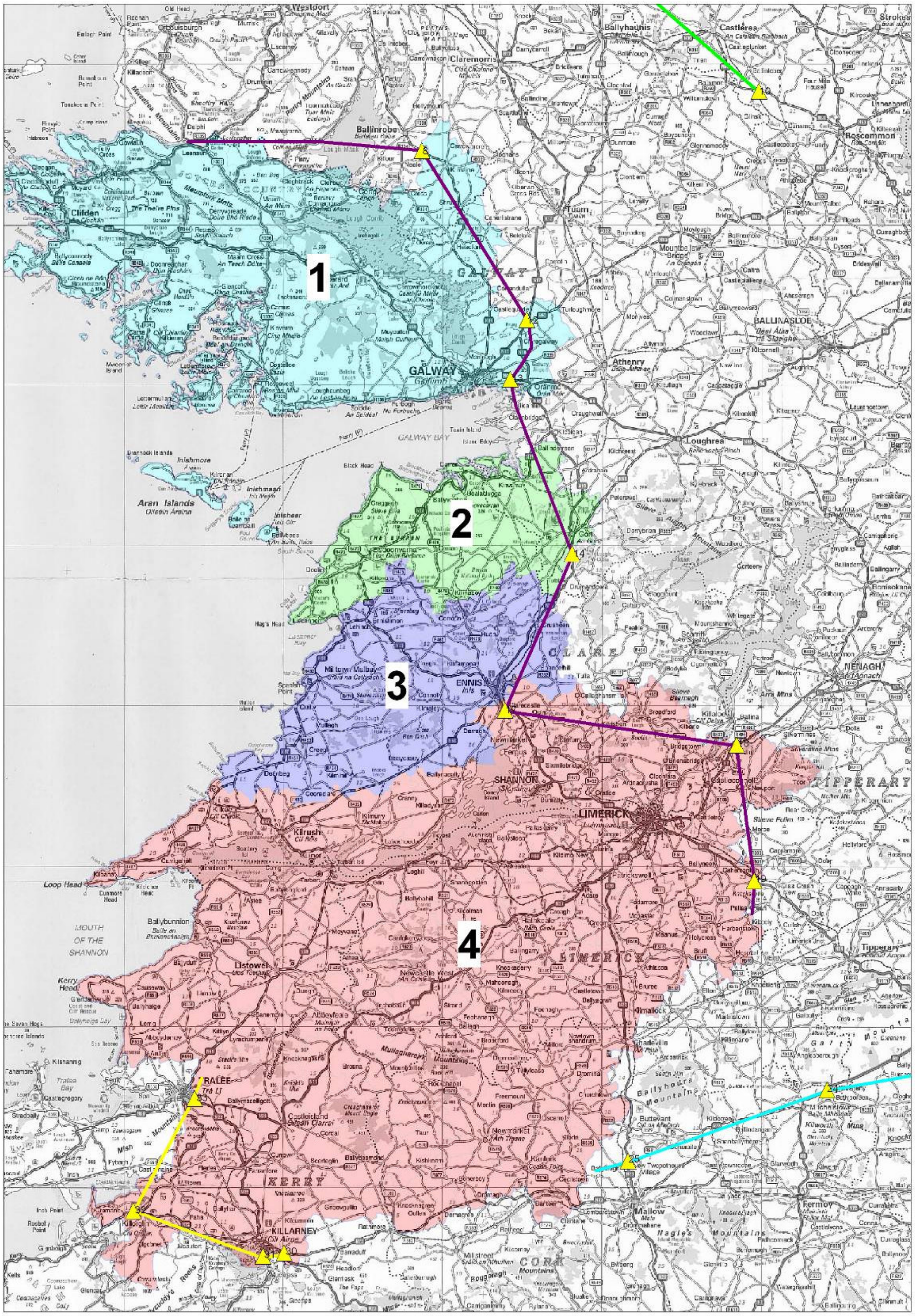
1.1.1 Sector 4 – Western Sector

Due to the definition of the Western Sector boundary it was felt that there was a good chance that double counting would occur for some trips starting and finishing in the sector itself (intra sector trips). In particular, the strategic road network provides a clear route between the cities of Limerick and Galway that passes through more than one RSI site. To account for this observation sub areas (as illustrated in Figure 1.1) were created and any trips going to and from the sub-areas were divided by values shown in the table 1.2 below.

Table 1.2 – Sector 4 Intra-sector trips double counting matrix

From/to	1	2	3	4
1	1	1	2	3
2	1	1	1	2
3	2	1	1	1
4	3	2	1	1

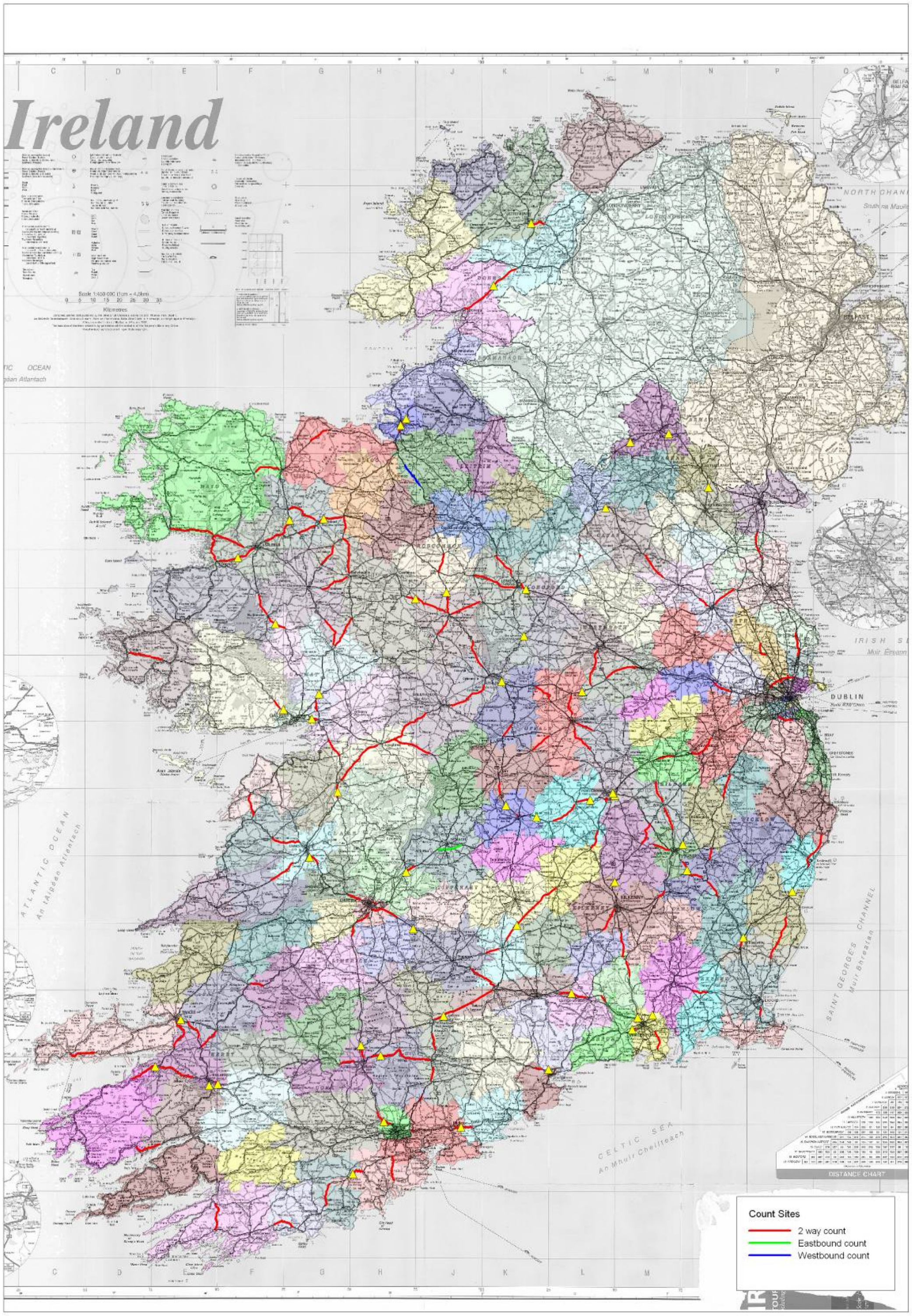
Figure 1.1 – Sector 4 Sub Areas



2.0 Sub-Sectors

Figure 2.1 below illustrates the 168 defined sub-sectors based on the aggregation of the 874 zones.

Figure 2.1 – 168 Sub-Sectors



3.0 Direct Demand Charts

The direct demand charts for each trip purpose are outlined below.

Figure 3.1 – Home Based Work Regression (Composite variable)

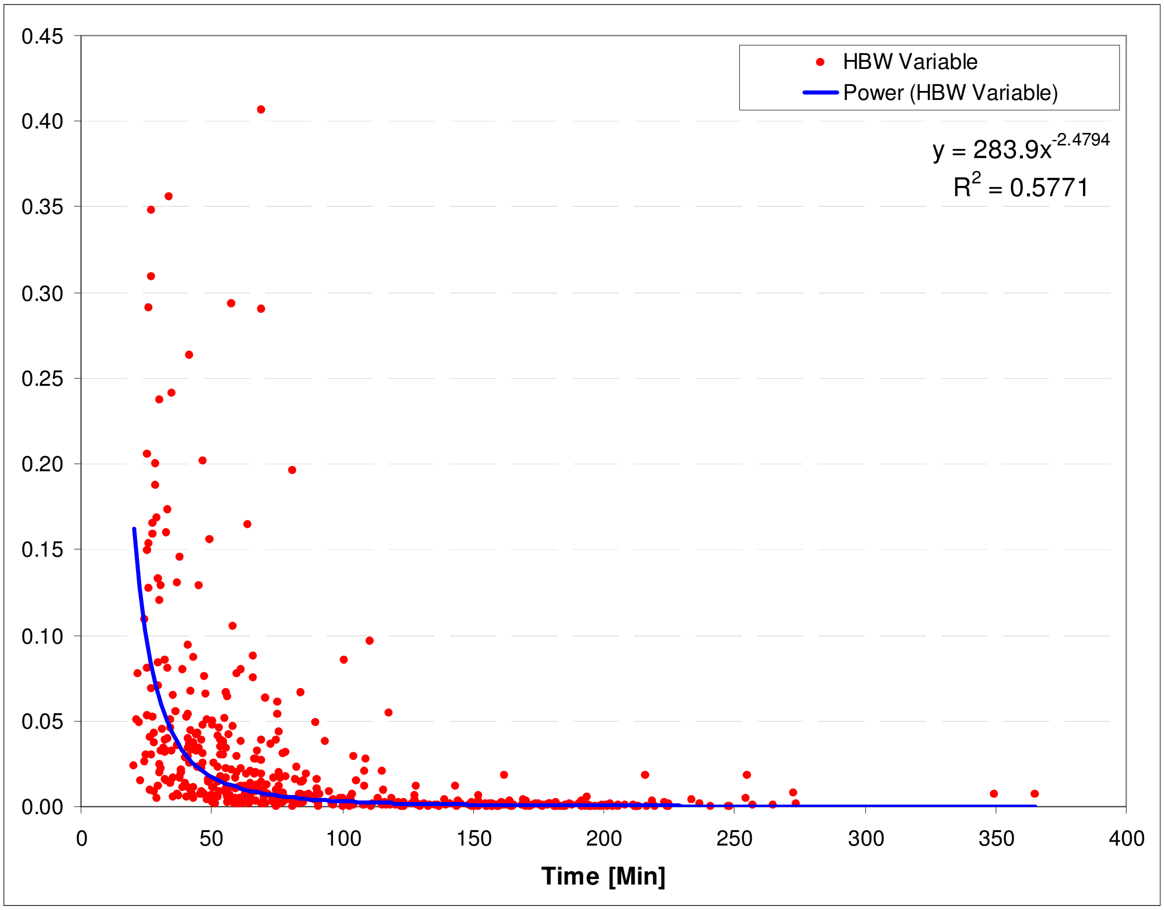


Figure 3.2 – Home Based Employers Business Regression (Composite variable)

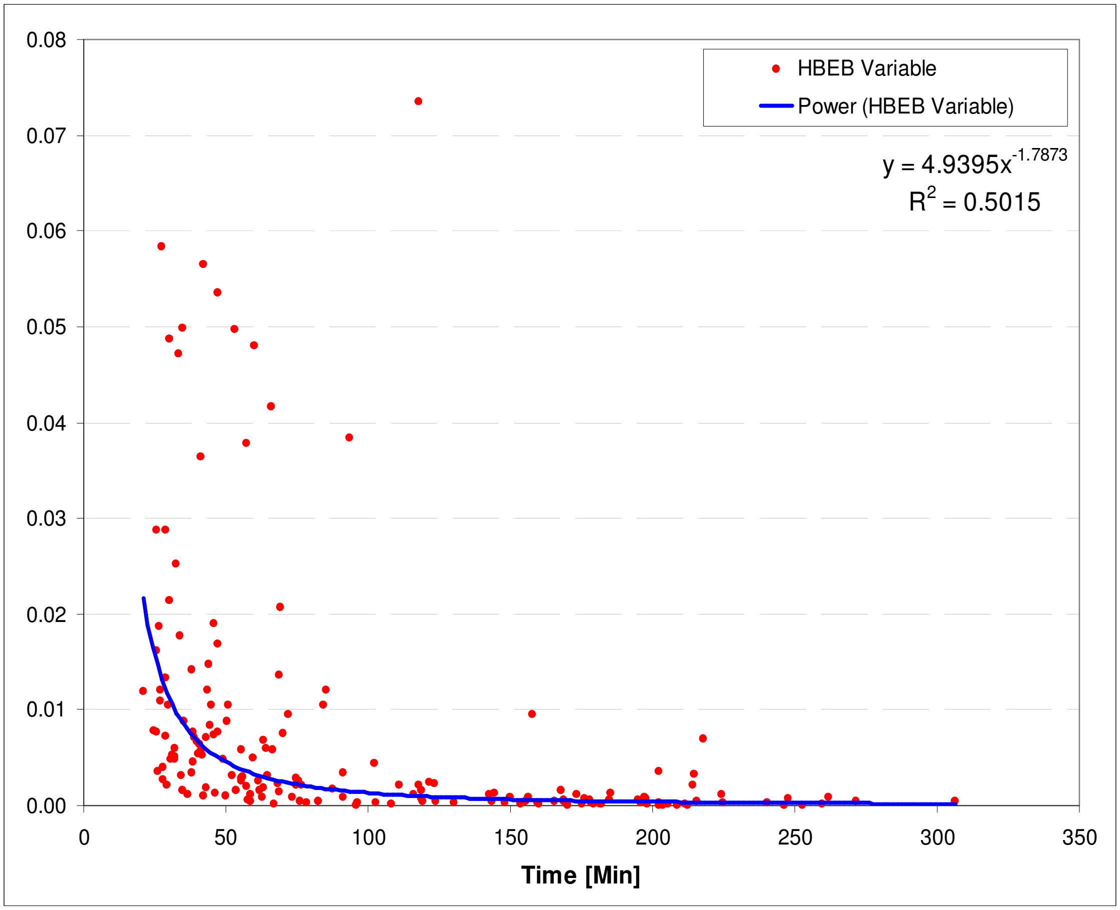


Figure 3.3 – Home Based Education Regression (Composite variable)

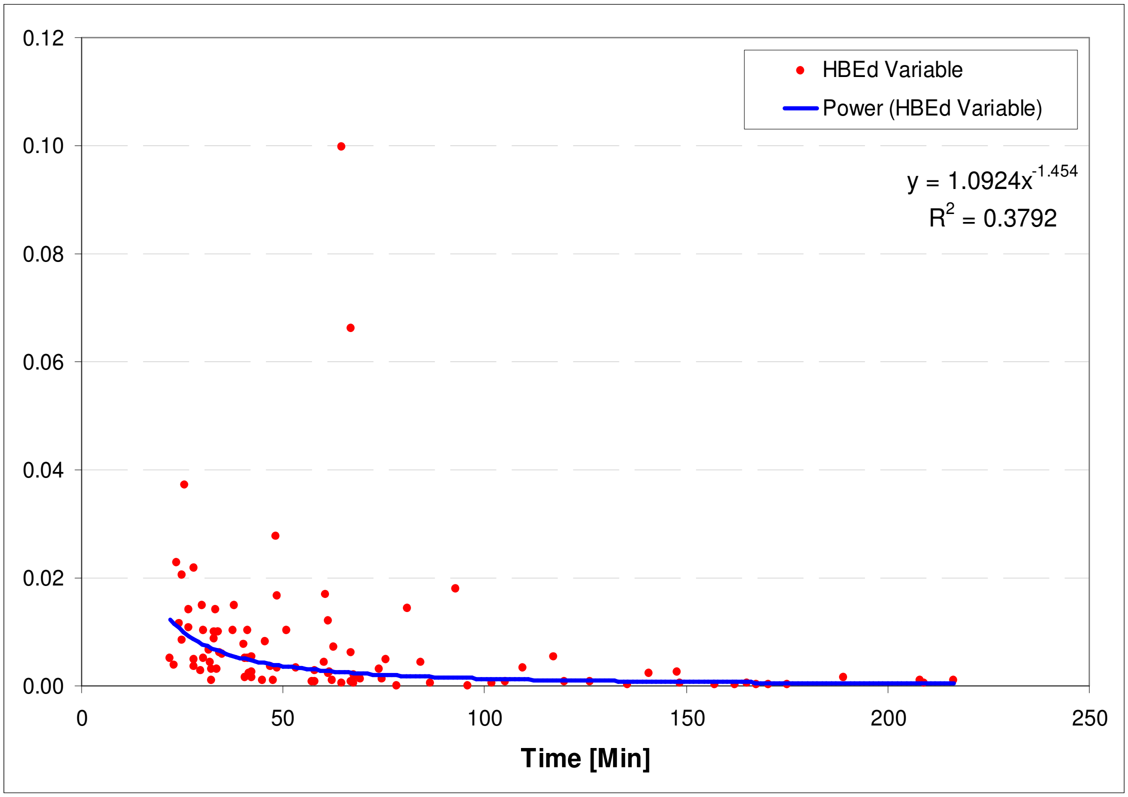


Figure 3.4 – Home Based Other Regression (Composite variable)

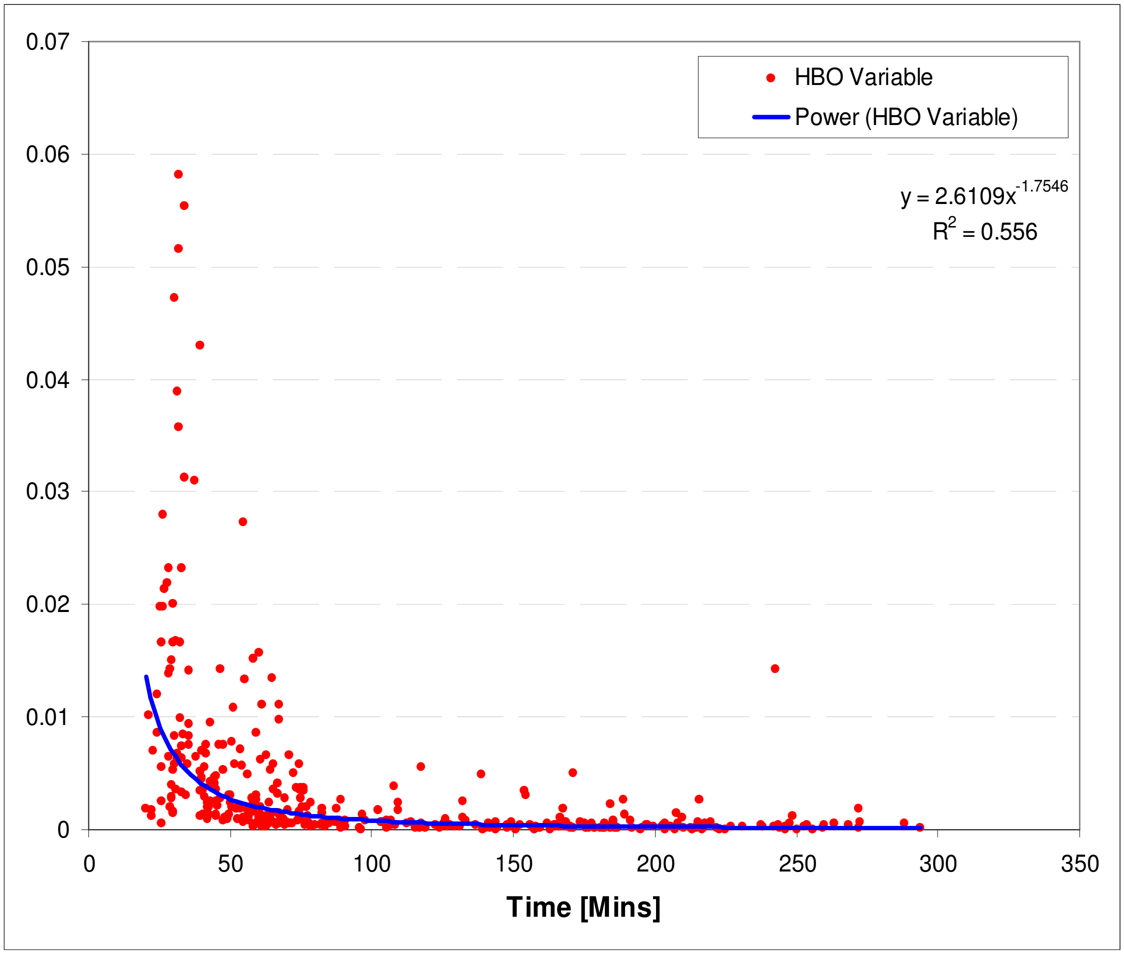


Figure 3.5 – Non-Home Based Employers Business Regression (Composite variable)

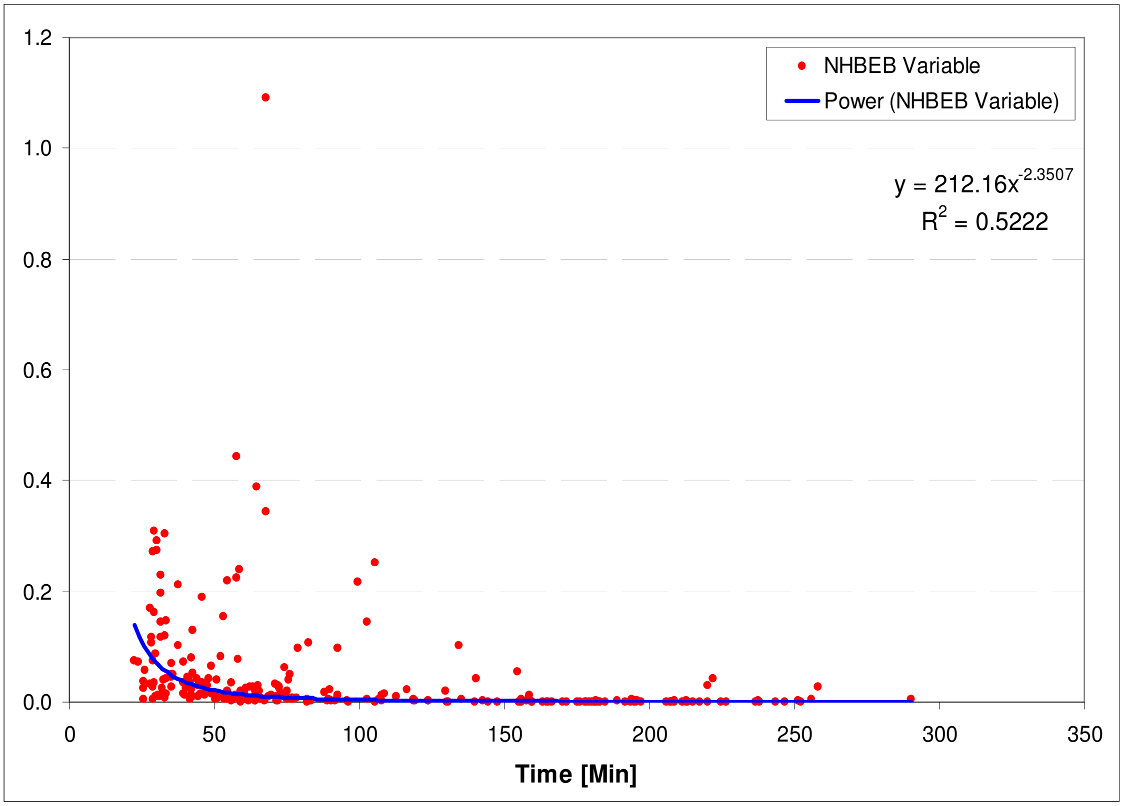


Figure 3.6 – Non-Home Based Other Regression (Composite variable)

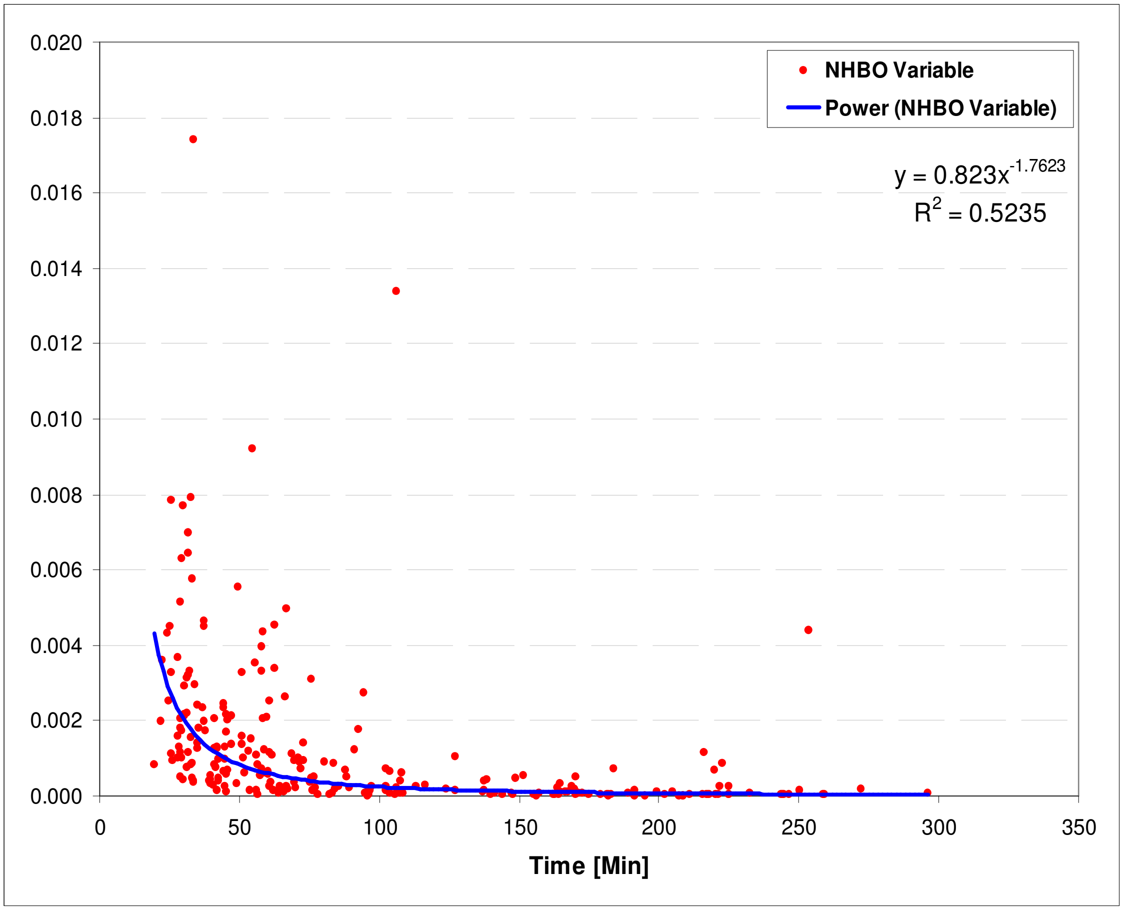
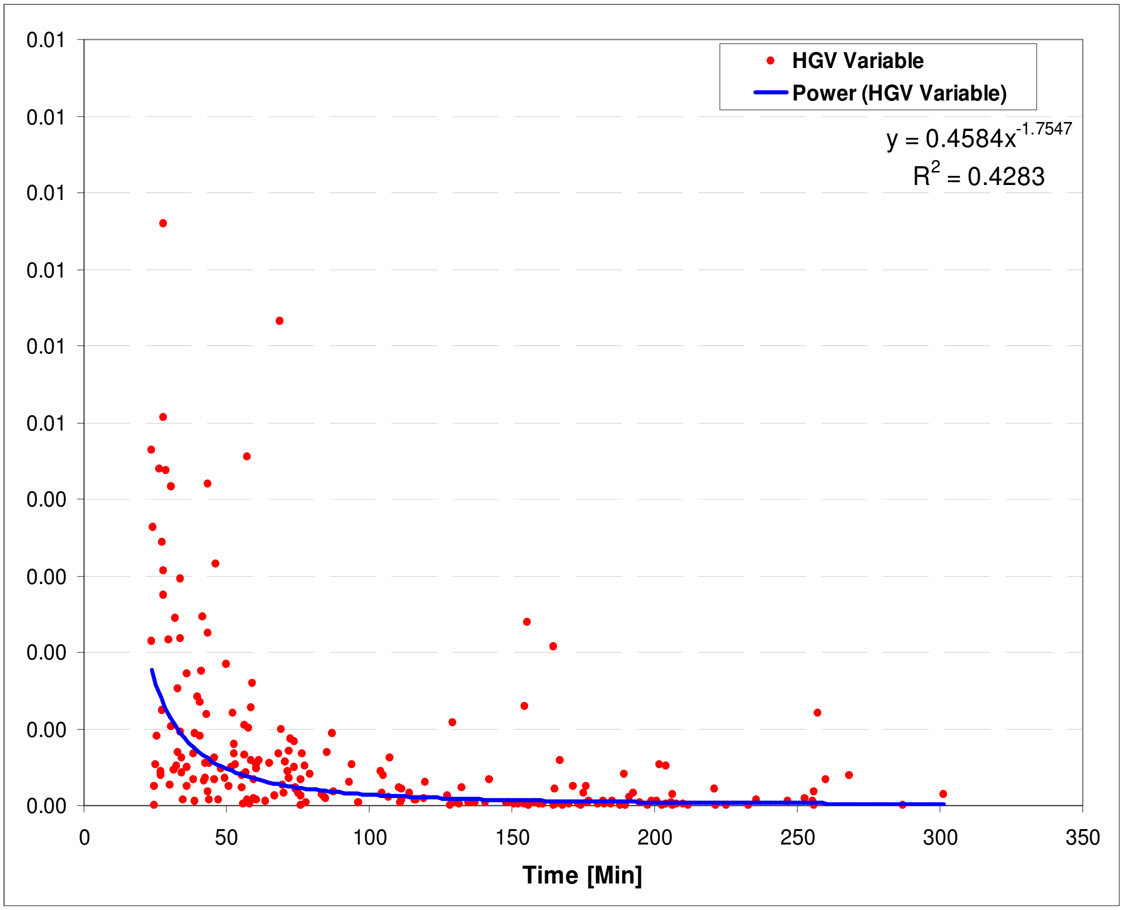


Figure 3.7 – Heavy Goods Vehicles Regression (Composite variable)



4.0 Trip End Model Regression Equation

Table 4.1 – Trip End Model – Origin Light Vehicles Regression Summary

Regression Statistics	
Multiple R	0.961225384
R Square	0.923954239
Adjusted R Square	0.915414193
Standard Error	1242.449199
Observations	128

Figure 4.1 – Light Vehicle Trip Ends [Origin] – Comparison of DOOR and Estimated Trips

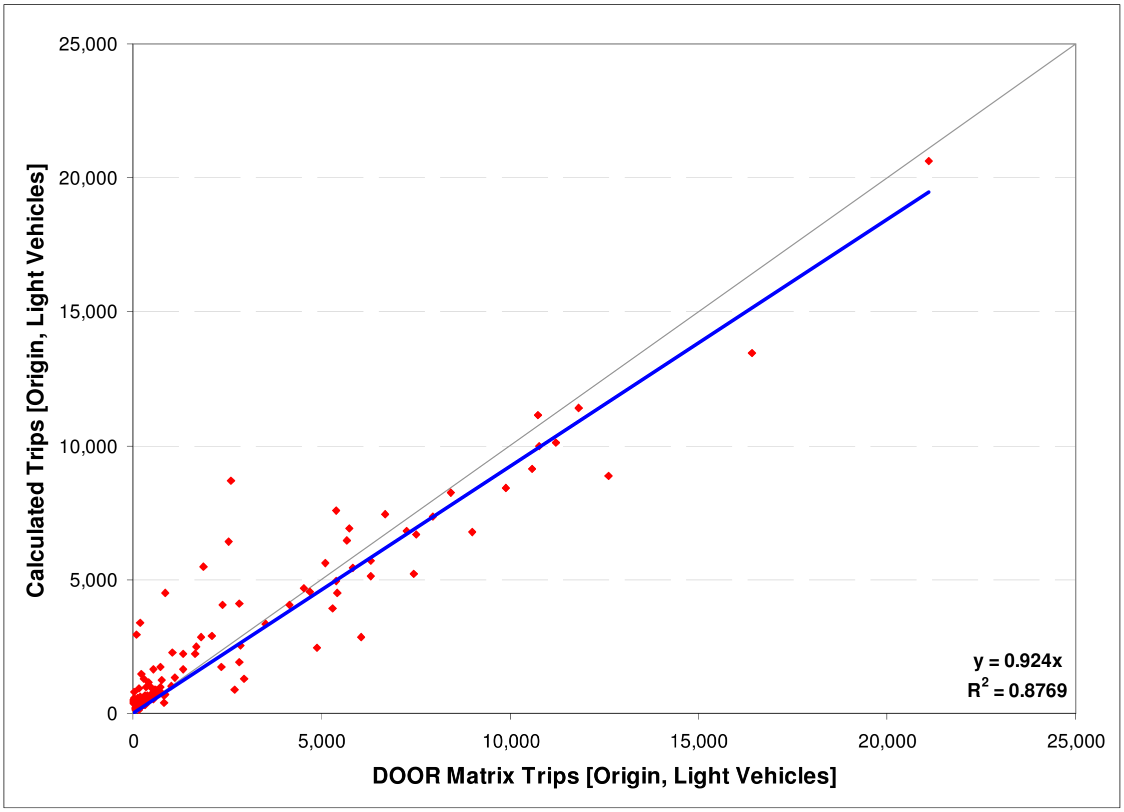


Table 4.2 – Trip End Model – Destination Light Vehicles Regression Summary

Regression Statistics	
Multiple R	0.955228112
R Square	0.912460747
Adjusted R Square	0.903829483
Standard Error	1345.242599
Observations	128

Figure 4.2 – Light Vehicle Trip Ends [Destination] – Comparison of DOOR and Estimated Trips

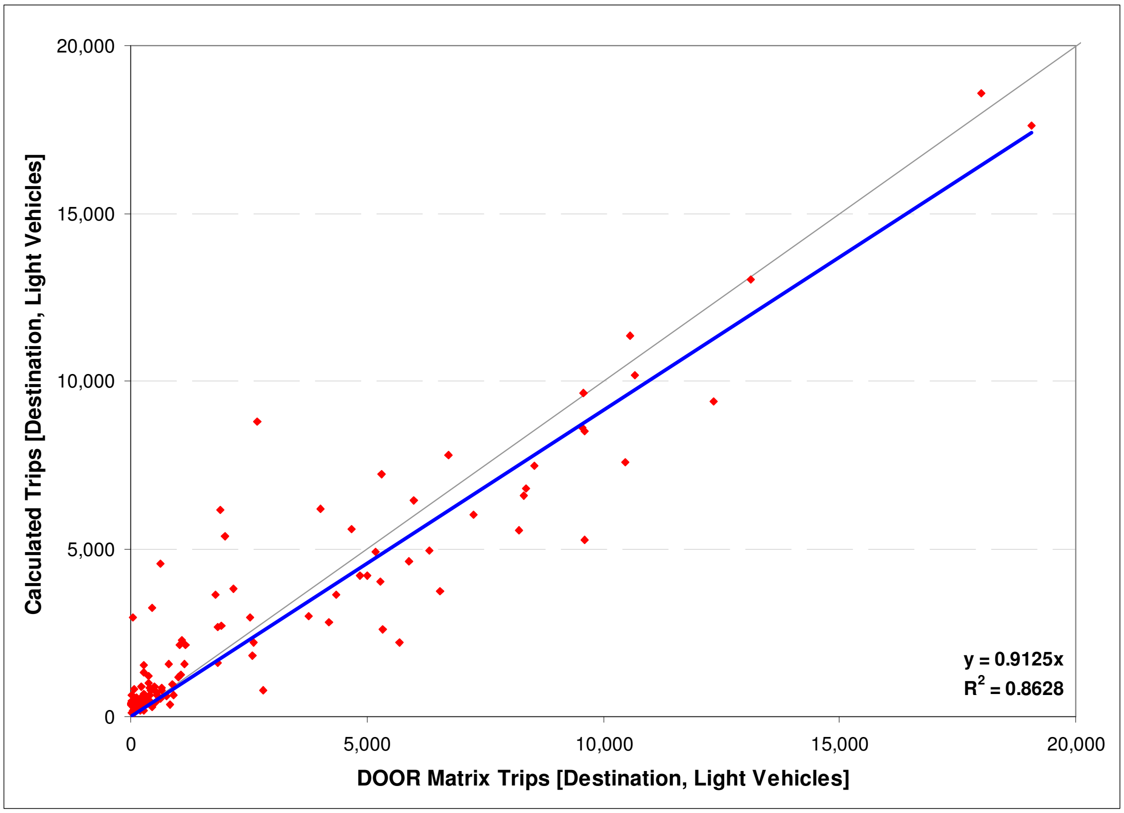


Table 4.3 – Trip End Model – Origin Heavy Goods Vehicles Regression Summary

Regression Statistics	
Multiple R	0.847507499
R Square	0.718268962
Adjusted R Square	0.705761265
Standard Error	136.6564685
Observations	128

Figure 4.3 – Heavy Goods Vehicle Trip Ends [Origin] – Comparison of DOOR and Estimated Trips

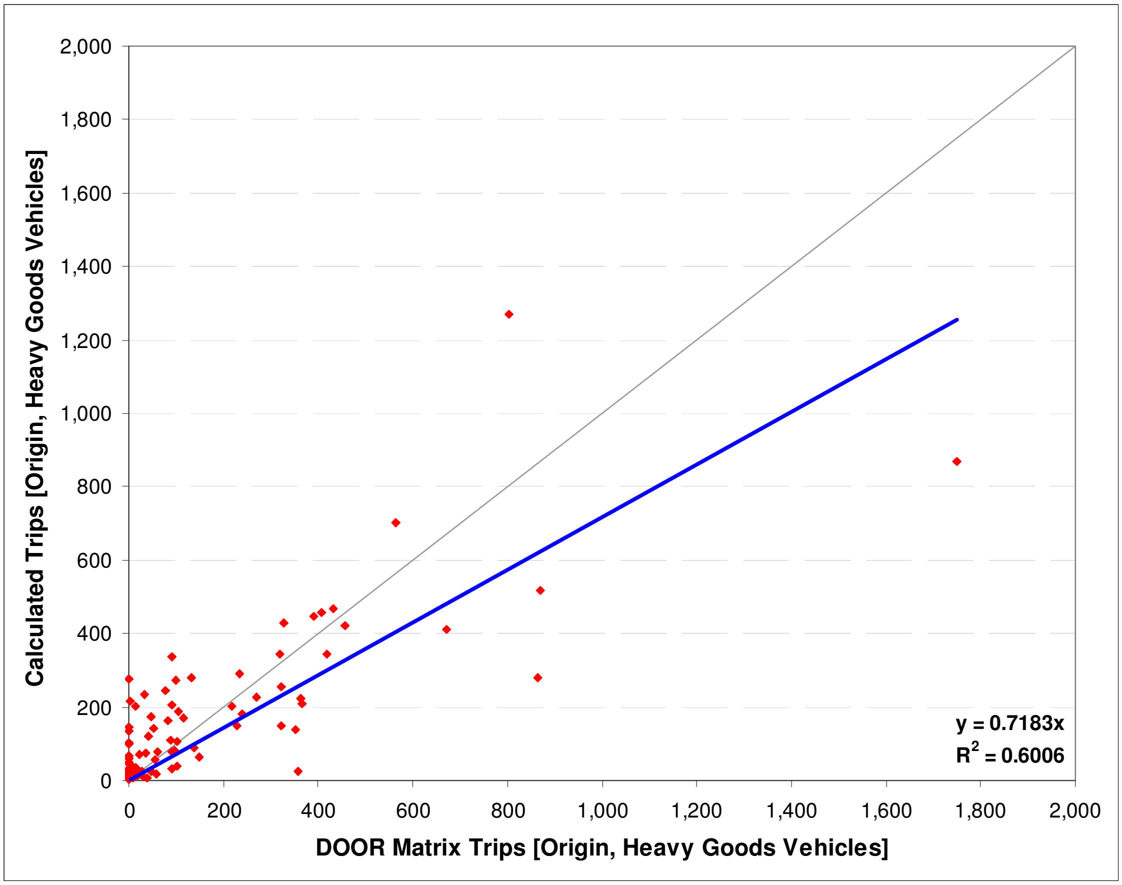
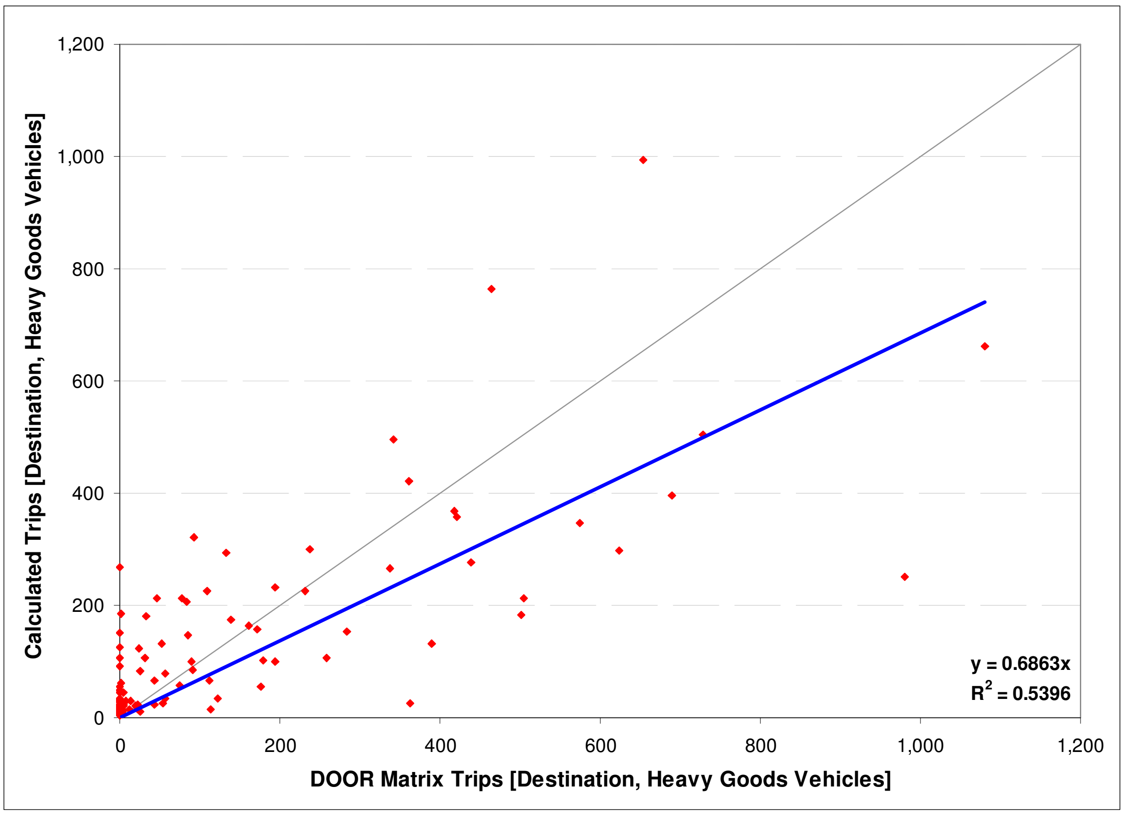


Table 4.4 – Trip End Model – Destination Heavy Goods Vehicles Regression Summary

Regression Statistics	
Multiple R	0.828417014
R Square	0.686274748
Adjusted R Square	0.675848357
Standard Error	130.1934668
Observations	128

Figure 4.4 – Heavy Goods Vehicle Trip Ends [Destination] – Comparison of DOOR and Estimated Trips



5.0 Pre Matrix Estimation Checks

Checks were carried out on the Pre Matrix Estimated (Pre ME) matrices to verify that the trips produced appeared reasonable. It was anticipated that higher number of trips (movements) would occur between the near by locations. This is verified by the following exercise which leads to the conclusion that the matrix development process adopted was acceptable.

Trips were aggregated to sub-sector and sector level with the prime intention of reducing the number of observations so graphs could be plotted and relationship verified. Inter sub-sector trips were included, but intra (internal) sub-sector trips were excluded as they generally represented non strategic traffic. It was expected that the number of trips between sub-sectors with higher populations would have more originating or destination trips compared with low population sub-sectors, and sub-sectors with greater distance between them would have fewer trips than sub-sectors with less distance between them.

It was also assumed that the number of trips generated between the origin and destination sub-sectors would depend on the relationship of following three variables:

- Origin sub-sector population;
- Destination sub-sector population; and
- Time taken to travel between sub-sectors

A new ‘Pop-Time’ variable was formed by the following relationship. The ‘Pop-Time’ variable will have a high value when either the population of originating and / or destination sub-sector is high or the travel time is small.

$$Pop\_Time\ \text{variable} = \frac{(Origin\ subsector\ population \times Destination\ subsector\ population) \times (Travel\ time)^{-2}}{100{,}000}$$

The analysis was simplified by using population as the sole demographic variable; however this was considered appropriate for the purpose of this exercise.

5.1 Verification at sub-sector level

Origin and destination sub-sector trips were plotted against the Pop-Time variable and a trend line on logarithm scale was plotted with a constant of zero. R-square values were obtained for each matrix. The highest r-square of 0.48 was obtained for AM-Lights trips whereas lowest value of 0.29 was observed for AM-HGV trips.

The charts are shown in Figures 5.1 – 5.5. Generally it can be seen that there are a higher number of trips between sub-sectors where the Pop-Time variable is high (this is where either the population of the originating zone and/ or destination zone is high and/ or the distance between the sub-sectors is small). The highest trips were made from sub-sector 164 to 9 for all the modes, except AM-HGV. The population of sub-sector 9 was 133,330 which is highest among all the sub-sectors whereas population of sub-sector 164 was 54,984 which is also high. The time required to travel from sub-sector 164 to 9 was 21 minutes, which is relatively small.

Overall, the r-square values for all modes are acceptable, and these are shown in Table 5.1 below. It can be seen that the r-square values are lower for the HGVs matrices than the Lights. During the matrix build the observed Light vehicle trips were generally found to have a better fit with the direct demand equation variables, and this better relationship is being shown to have been retained here.

Table 5.1: Pre ME Checks – R-square values and estimated equations

Trip Purpose	R^2	Equation (Trips between Sub-sectors)
AM-Lights	0.48	1.6427 x (Population-Time variable)
AM-HGV	0.29	0.2522 x (Population-Time variable)
IP-Lights	0.52	3.740 x (Population-Time variable)
IP-HGV	0.36	0.222 x (Population-Time variable)
AM-POWCAR	0.34	3.0566 x (Population-Time variable)

Figure: 5.1 AM Lights

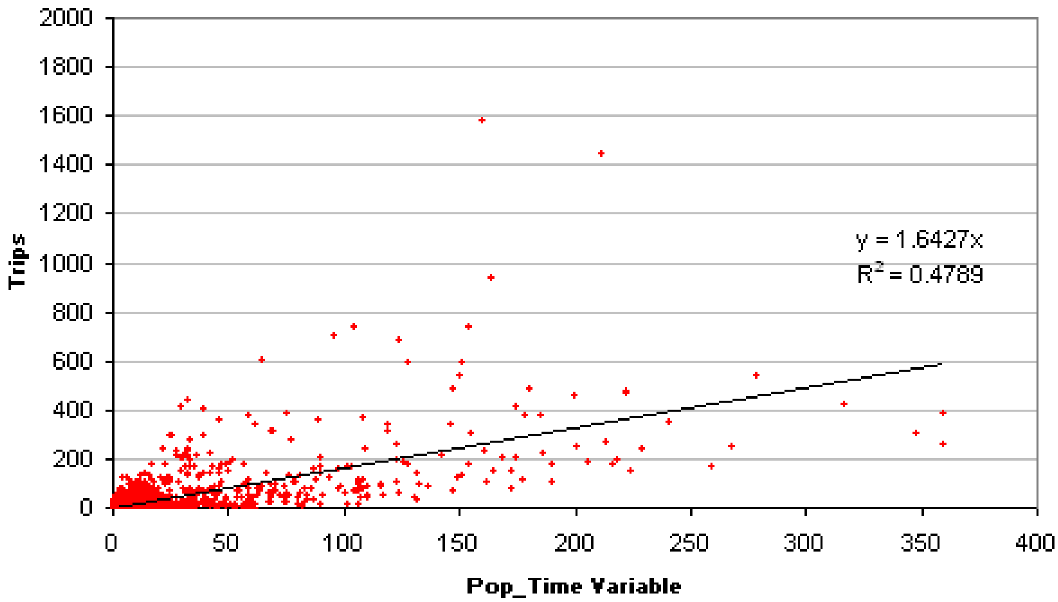


Figure: 5.2 AM HGV

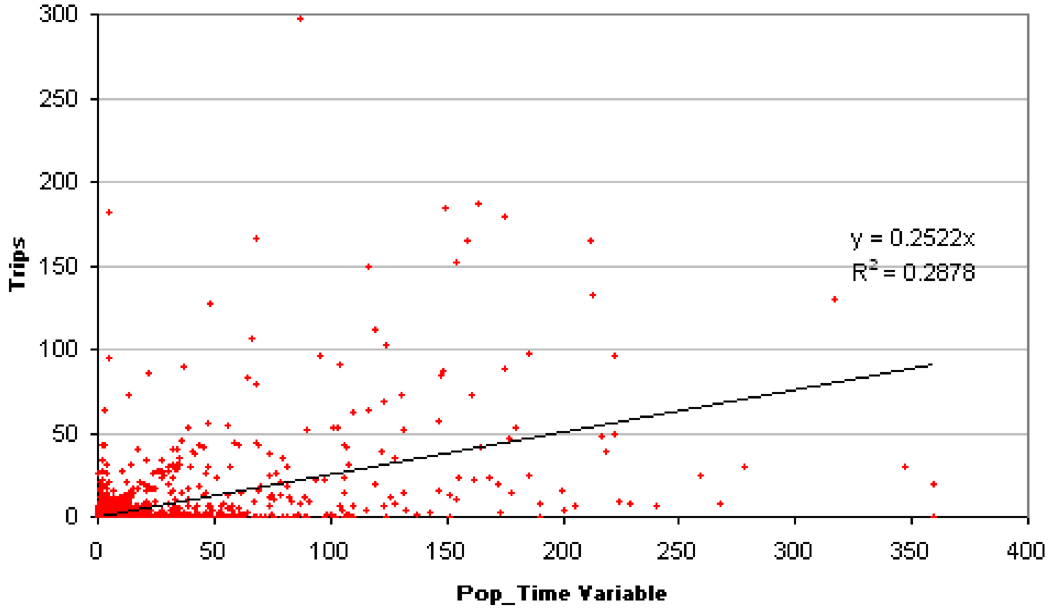


Figure: 5.3 IP Lights

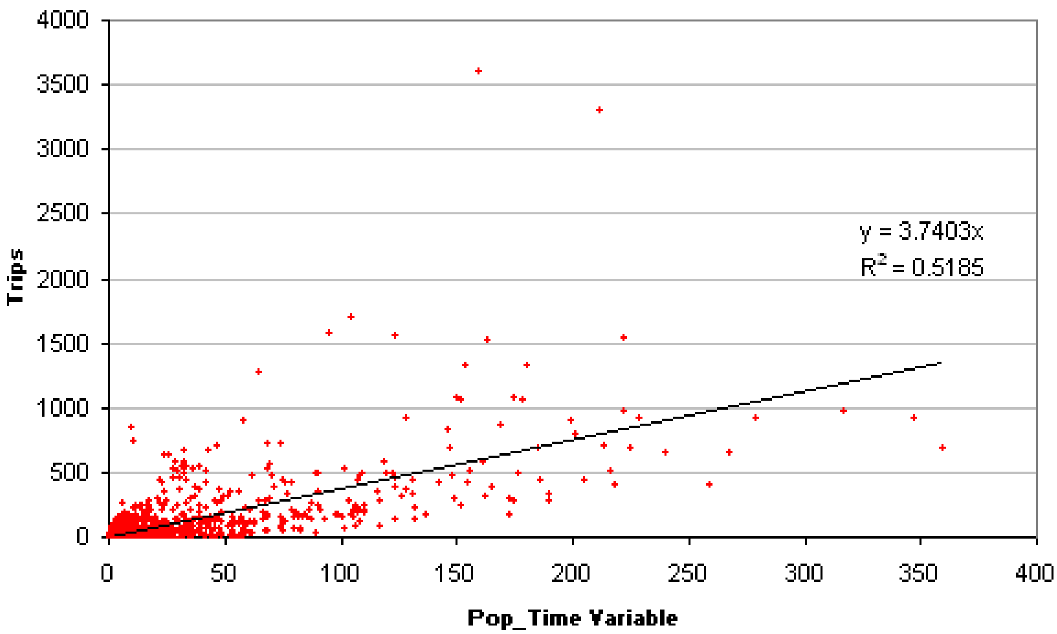


Figure: 5.4 IP HGV

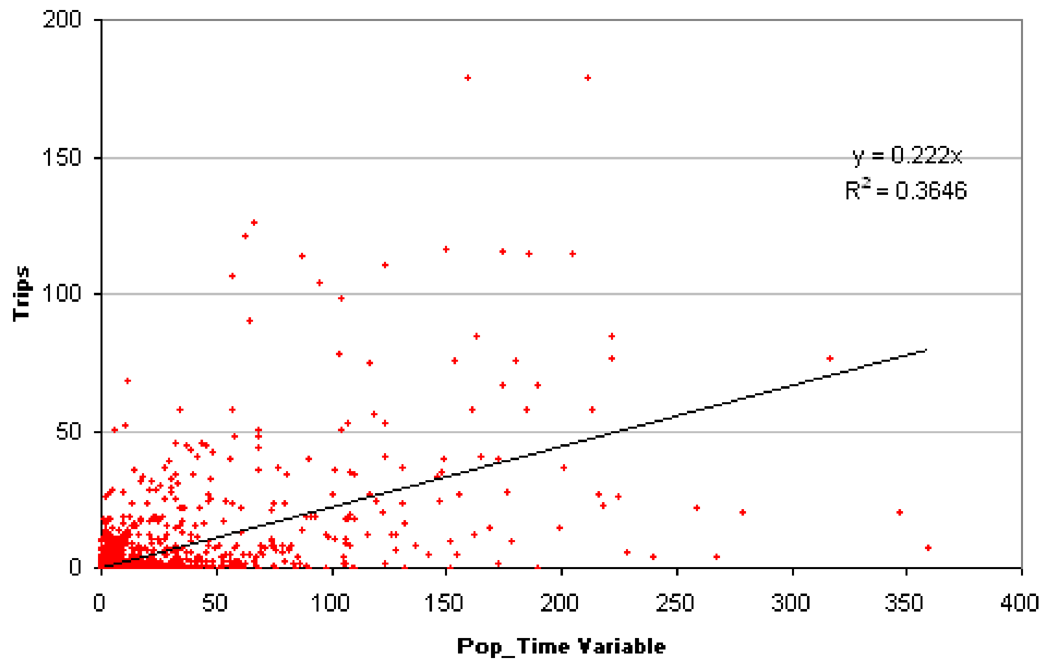
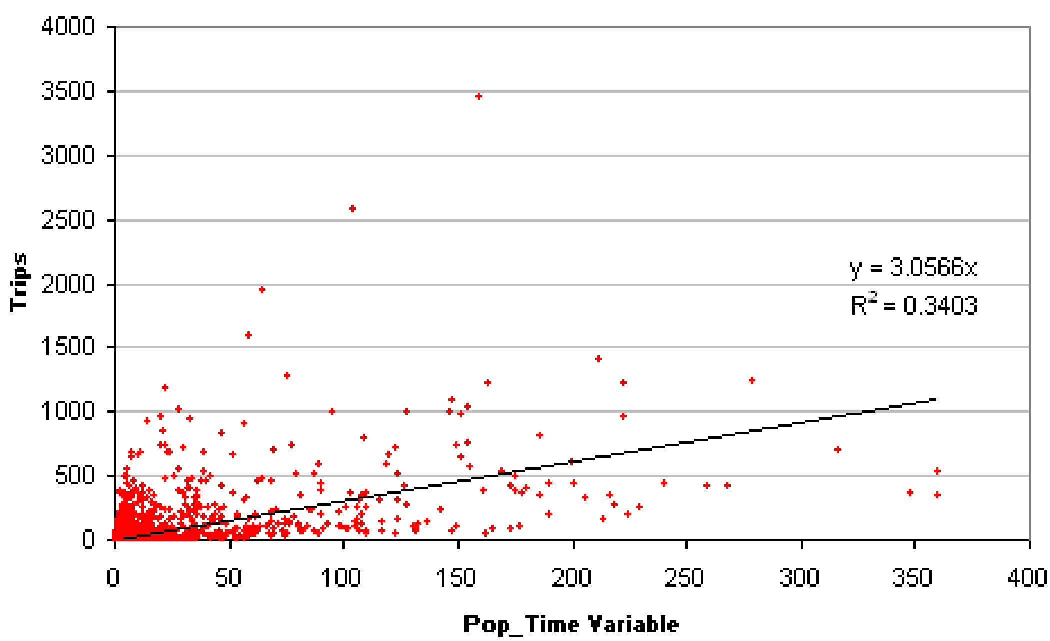


Figure: 5.5 AM POWCAR



5.2 Verification at sector level

The trips were aggregated from sub-sector to sector level and cross tabulated results produced. For AM-Light and AM-POWCAR the highest numbers of trips were made from Central sector to Sector 1 whereas for all other modes highest trips were from Sector 1 to the Central sector.

It is assumed that neighbouring / nearby sectors will produce more trips between. This is verified from all the tables shown below. In each row it can be seen that the highest number of trips occur between neighbouring sectors. For AM-Lights trips, the highest number of originating trips from Sector 1 was 505 which had destination in the Central sector which was a neighbouring sector. In the same way 556 trips originated from sector Central to Sector 1 which was highest number of trips made by AM-Lights among all the combinations of sectors. The Central sector clearly has other neighbouring sectors, however Sector 1 has a high population and this is expected to generate a relatively high number of trip ends. Each row from the tables was checked individually to confirm that highest number of trips are produced for neighbouring and near by sectors.

Table 5.6: AM-Lights trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	78	11	117	49	38	0	505	7
2	82	-	359	286	11	15	0	250	11
3	8	348	-	68	0	1	0	3	0
4	58	277	117	-	5	216	0	552	8
5	46	7	0	51	-	0	0	89	0
6a	29	23	0	81	0	-	7	228	25
6b	6	0	0	0	0	39	-	167	142
Central	556	524	0	489	106	328	259	-	66
NI	16	0	1	23	0	4	121	52	-

Table 5.7: AM-HGV trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	34	2	28	16	6	0	240	0
2	16	-	60	120	26	7	0	52	0
3	0	57	-	10	0	0	0	0	0
4	25	60	19	-	0	21	0	80	2
5	47	0	0	0	-	0	0	43	0
6a	2	9	0	35	0	-	9	44	3
6b	4	0	0	0	0	8	-	0	42
Central	132	55	2	94	17	26	62	-	15
NI	114	0	0	31	0	11	8	29	-

Table 5.8: IP-Lights trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	204	27	190	159	81	0	1466	57
2	140	-	711	365	90	4	0	599	14
3	21	683	-	263	24	0	0	4	0
4	149	427	548	-	14	150	0	1029	8
5	78	212	0	19	-	0	0	100	0
6a	76	8	0	330	0	-	10	826	18
6b	13	0	0	0	0	45	-	1169	167
Central	1216	878	9	1570	237	848	1052	-	196
NI	45	3	0	38	0	36	325	214	-

Table 5.9: IP-HGV trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	30	1	19	11	17	0	341	0
2	3	-	65	89	5	2	0	31	4
3	3	62	-	7	0	0	0	1	0
4	32	89	31	-	1	42	0	57	0
5	26	0	0	0	-	0	0	42	0
6a	23	2	0	6	0	-	1	44	0
6b	0	0	0	0	0	0	-	38	0
Central	146	36	4	104	32	49	68	-	8
NI	0	1	0	4	0	9	0	66	-

Table 5.10: AM-POWCAR trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	11	0	11	65	4	0	4096	0
2	17	-	730	493	58	0	0	1399	0
3	0	871	-	1293	0	0	0	5	0
4	9	757	2285	-	0	259	0	1828	0
5	143	83	0	0	-	0	0	755	0
6a	6	0	0	391	0	-	3	1199	0
6b	0	0	0	0	0	5	-	617	0
Central	4621	2068	6	5700	1260	2437	1049	-	0
NI	0	0	0	0	0	0	0	0	-

6.0 Post Matrix Estimation Checks

The same checking procedure to that described for the Pre ME matrix was carried out for the Post ME matrices to verify that the distribution of trips appeared reasonable.

6.1 Verification at sub-sector level

Trips at a sub-sector level were plotted against the Pop-Time variable (as defined in the Pre ME checking appendix); the charts are shown in Figures 6.1 – 6.5. Table 6.1 displays the r-square values for each matrix which show that overall the relationship between trips and the Pop-Time variable is acceptable for all matrices. The highest r-square value of 0.51 is observed for IP-Car whereas lowest value is for AM-Peak HGV. The r-square values and equations produced are similar to the Pre ME matrices indicating that the general distribution of trips at a sub-sector level has been retained in the Post ME matrices. This is further supported by the pattern of the charts.

Table 6.1: R-square and estimated equations

Trip Purpose	R^2	Equation (Trips between Sub-sectors)
AM-Peak Car	0.46	1.5749 x (Population-Time variable)
AM-Peak HGV	0.30	0.2705 x (Population-Time variable)
IP-Car	0.51	3.7039 x (Population-Time variable)
IP-HGV	0.37	0.2197 x (Population-Time variable)
AM-POWCAR	0.35	2.9354 x (Population-Time variable)

Figure: 6.1 AM Lights

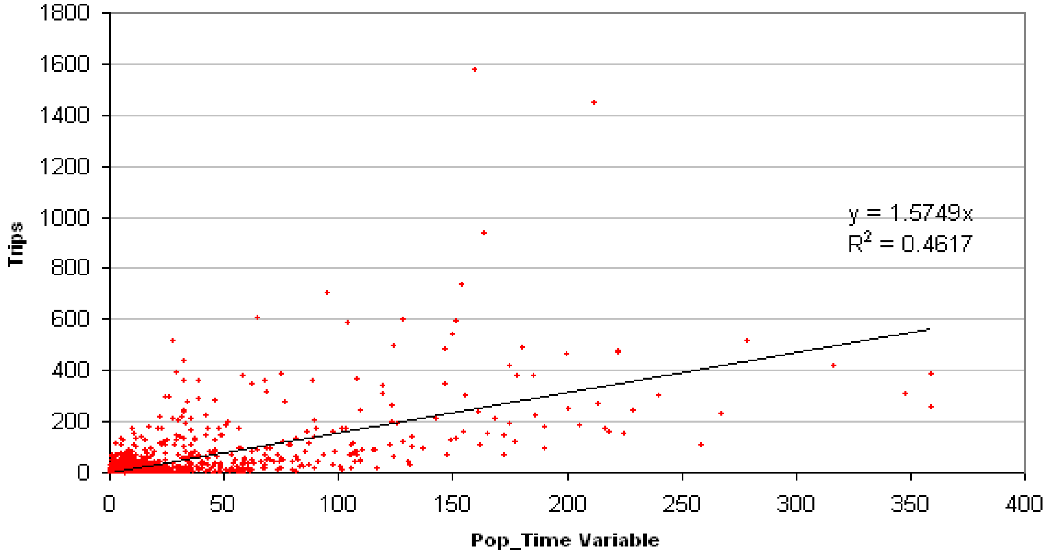


Figure: 6.2 AM Peak HGV

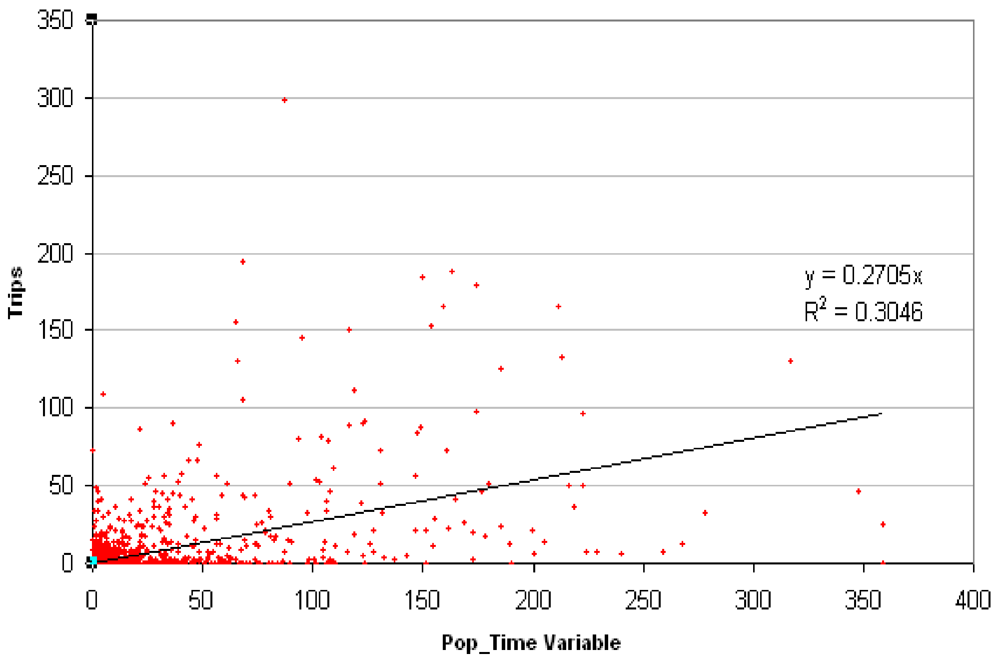


Figure: 6.3 IP Car

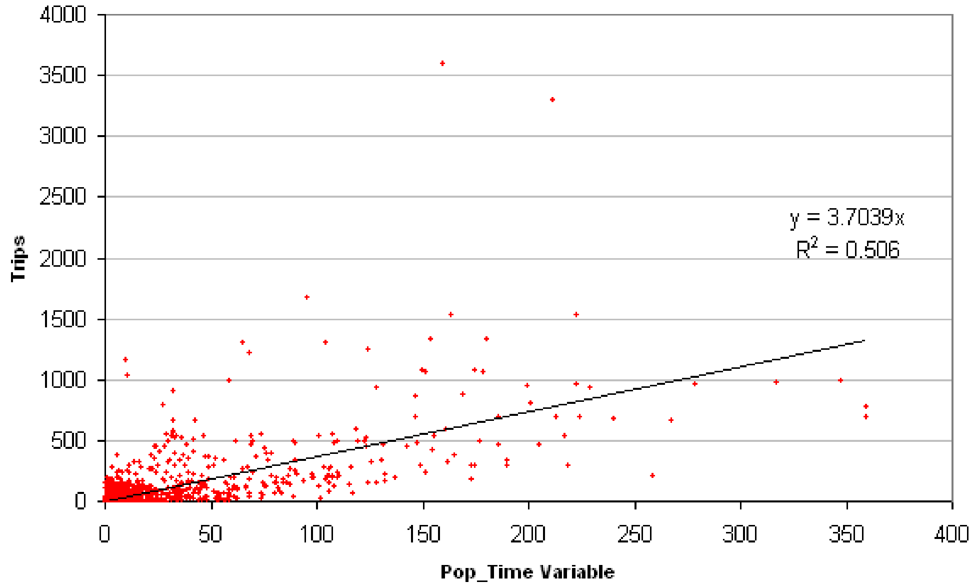


Figure: 6.4 IP HGV

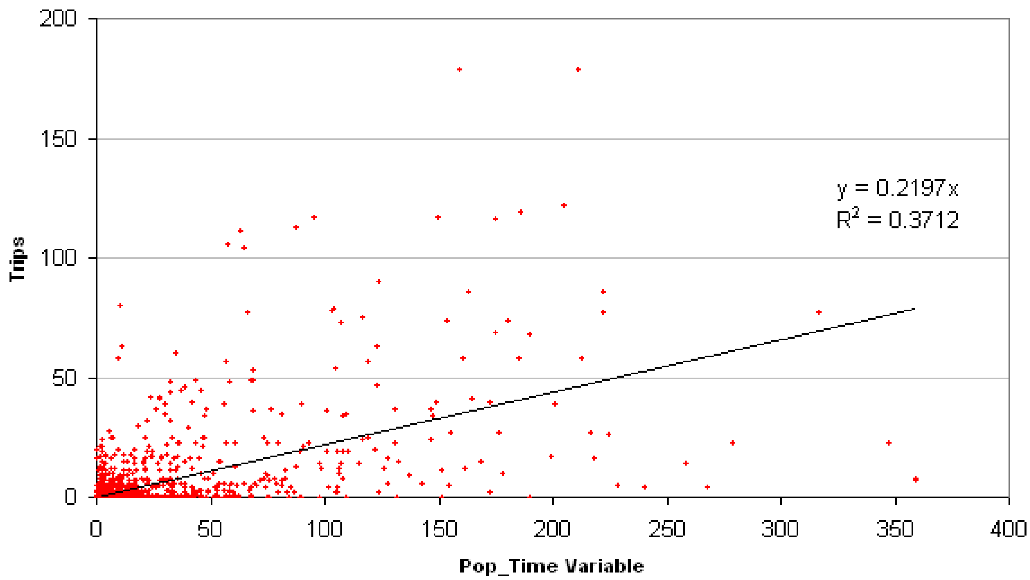
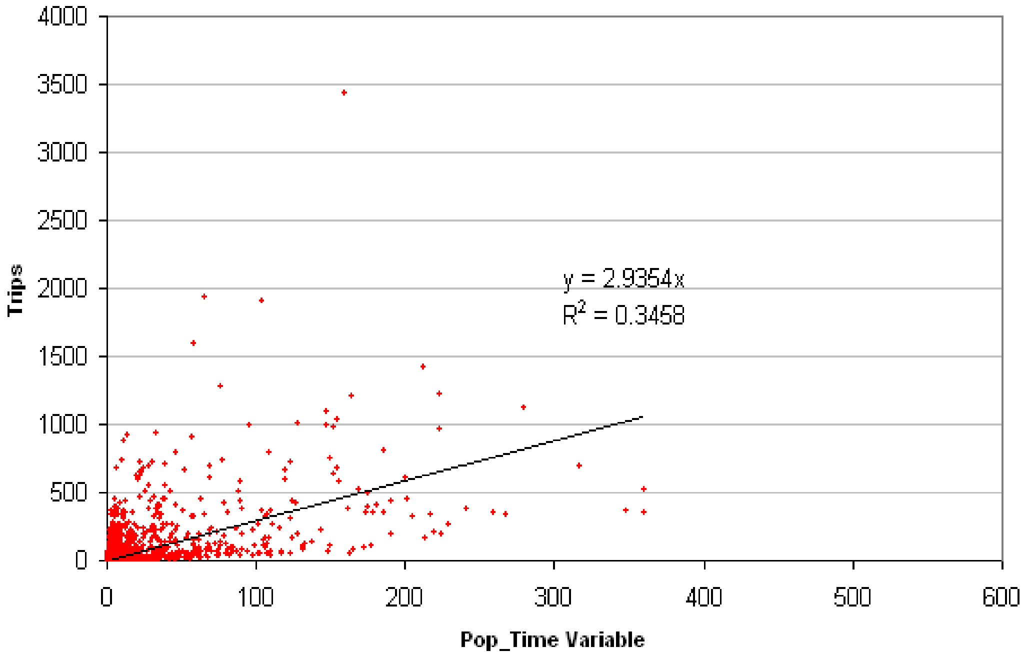


Figure: 6.5 AM Peak POWCAR



6.2 Verification at sector level

Trips were aggregated from sub-sector to sector and cross tabulated; the results are shown in Tables 6.2 – 6.6. The pattern of trips was checked and compared with the Pre ME trip patterns, as shown in the previous appendix. It was found that although the matrix trips totals were generally retained, some differences did occur in the number of trips between sectors.

For AM-Peak cars and AM-peak POWCAR the highest number of trips occurred from the Central sector to Sector 1, and this pattern was found to be the same as in the Pre ME matrices. For AM-Peak HGV the highest trips occurred from Northern Ireland (NI) to Sector 1, which is different in the Pre ME matrices. The highest number of trips between sectors for IP-Car is also different in the Pre ME matrices; the highest number of trips for IP-HGV remains the same.

As in Pre ME it is assumed that neighbouring sectors will produce more trips between them compared to non neighbouring sectors (due to them being further away from each other). The tables show that this assumption generally remains true for the Post ME matrices. There are a number of incidences in the HGV matrices which go against this assumption, however it could be argued that HGV's have different trip patterns, which have been affirmed during the matrix estimation process. The average trip length for HGV's exceeds that for lights in both time periods which is as expected.

Table 6.2: AM-Peak Car trips

Origin /Destination Sector	1	2	3	4	5	6a	6b	Central	NI
1	-	11	13	64	58	30	0	190	5
2	15	-	140	179	30	1	0	190	8
3	4	165	-	73	0	0	0	0	0
4	39	150	136	-	0	123	0	343	2
5	90	9	0	39	-	0	0	88	0
6a	23	20	0	59	0	-	11	195	36
6b	6	0	0	0	0	42	-	198	297
Central	495	465	0	248	183	281	273	-	68
NI	20	0	0	16	0	2	178	45	-

Table 6.3: AM-Peak HGV trips

Origin /Destination Sector	1	2	3	4	5	6a	6b	Central	NI
1	-	79	5	84	34	2	0	104	9
2	35	-	26	61	73	10	0	19	0
3	0	23	-	12	0	0	0	0	0
4	74	49	15	-	0	6	0	19	6
5	77	0	0	0		0	0	62	0
6a	0	9	0	7	0	-	10	31	3
6b	0	0	0	0	0	7	-	0	84
Central	79	30	0	18	39	23	62	-	-
NI	125	0	0	29	0	17	19	29	11

Table 6.4: IP-Cars trips

Origin /Destination Sector	1	2	3	4	5	6a	6b	Central	NI
1	-	276	22	347	444	138	0	657	127
2	172	-	643	233	186	4	0	477	6
3	37	648	-	429	24	0	0	0	0
4	306	245	538	-	50	218	0	879	8
5	448	316	0	47	-	0	0	183	0
6a	87	2	0	326	0	-	3	828	13
6b	8	0	0	0	0	19	-	1489	287
Central	735	572	0	1026	339	982	1368	-	244
NI	265	0	0	24	0	19	577	196	-

Table 6.5: IP-HGV trips

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	49	0	24	19	13	0	122	0
2	17	-	11	25	1	0	0	3	0
3	0	9	-	0	0	0	0	0	0
4	36	24	10	-	1	9	0	12	0
5	42	0	0	0	-	0	0	9	0
6a	17	0	0	0	0	-	0	1	0
6b	0	0	0	0	0	0	-	60	0
Central	14	2	0	33	9	1	83	-	16
NI	0	0	0	3	0	5	0	60	-

Table 6.6: AM- Peak POWCAR

Origin /Destination Sector	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**	**Central**	**NI**
1	-	6	0	22	68	3	0	4719	0
2	13	-	704	460	148	0	0	1669	0
3	0	839	-	810	0	0	0	9	0
4	16	498	1591	-	0	193	0	1915	0
5	136	47	0	0	-	0	0	676	0
6a	13	0	0	290	0	-	0	1350	0
6b	0	0	0	0	0	2	-	1386	0
Central	5547	1847	6	4029	1201	1840	1341	-	0
NI	0	0	0	0	0	0	0	0	-

7.0 Total Trips and Trip Length Distributions

Further checks were carried out to analyse and verify any changes in trip length distributions and trip totals between the Pre and Post ME matrices. Intrazonal matrix totals were also checked.

7.1 Comparison of Trips Length Distributions

Histograms were plotted showing trip frequency against travel time on a zonal basis. Intrazonal trips were excluded. The y-axis represents the frequency of trips made and the x-axis represents trip length (travel time). The histograms show the Pre ME (in green) and Post ME (in red) matrices on the same plot.

Overall the pattern of trips is similar amongst the Pre and Post ME matrices, with the exception of the POWCAR matrices which are noticeably different. In the Post ME the frequency of the longer trips appears to have been slightly reduced whereas the frequency of smaller trips has slightly increased

In terms of POWCAR, there are clearly more trips in the Post ME matrix and the frequency of trips particularly in small time bands (up to 50 minutes) is clearly higher. The Post ME matrix trip totals have more or less been retained from the Pre ME matrices however the intrazonal totals (described in more detail below) have been reduced. This has facilitated more inter (between) zonal trips via the matrix estimation stage.

Figure 7.1: Comparison of pre and post estimation matrices (AM_Lights)

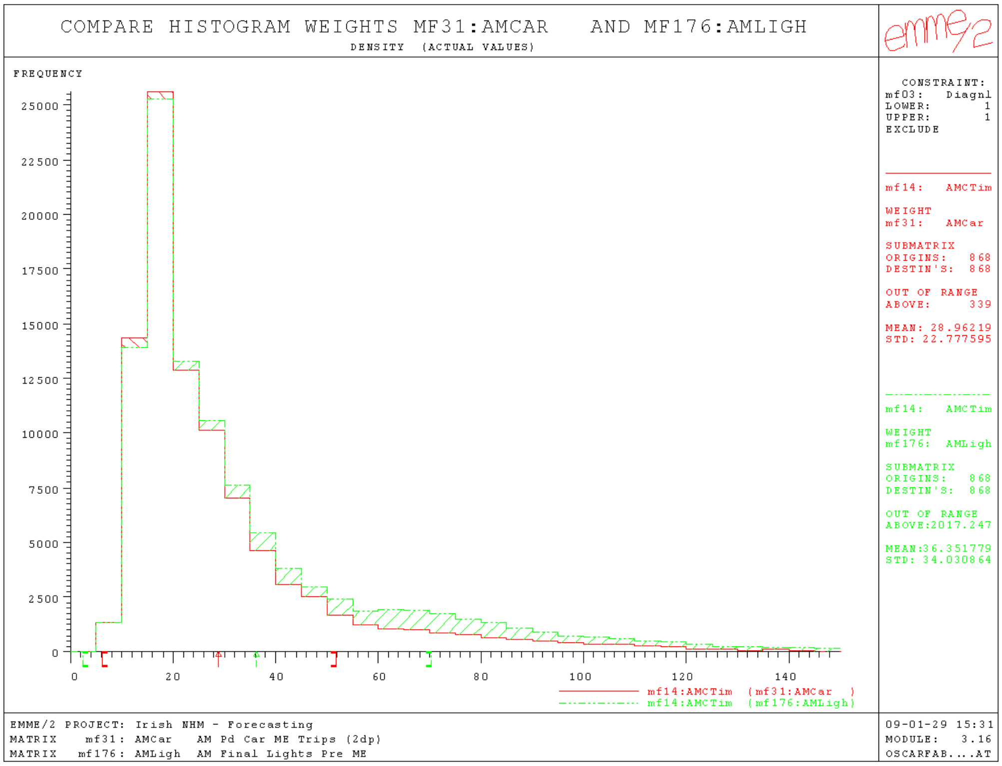
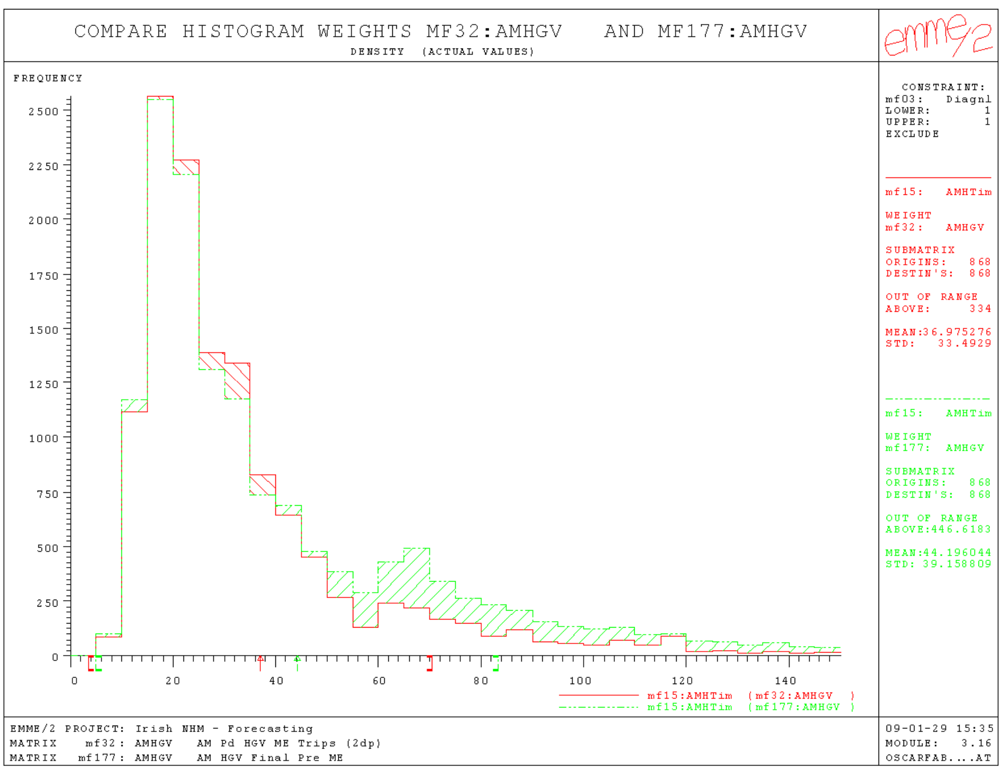


Figure 7.2: Comparison of pre and post estimation matrices (AM-HGV)



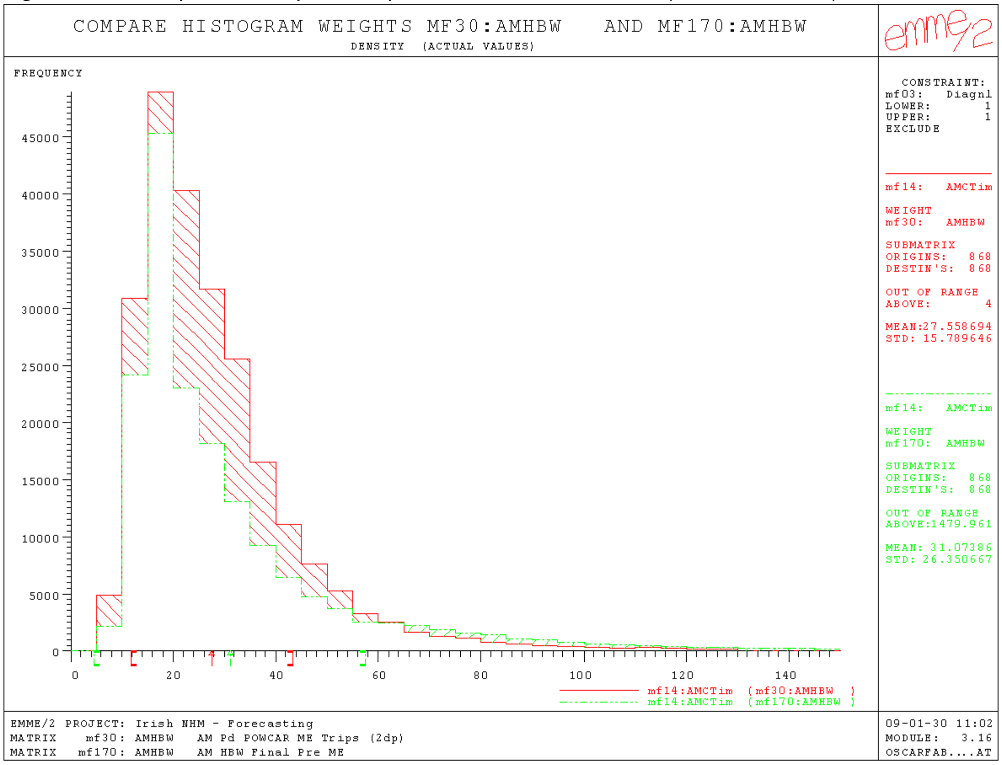


Figure 7.3: Comparison of pre and post estimation matrices (AM-POWCAR)

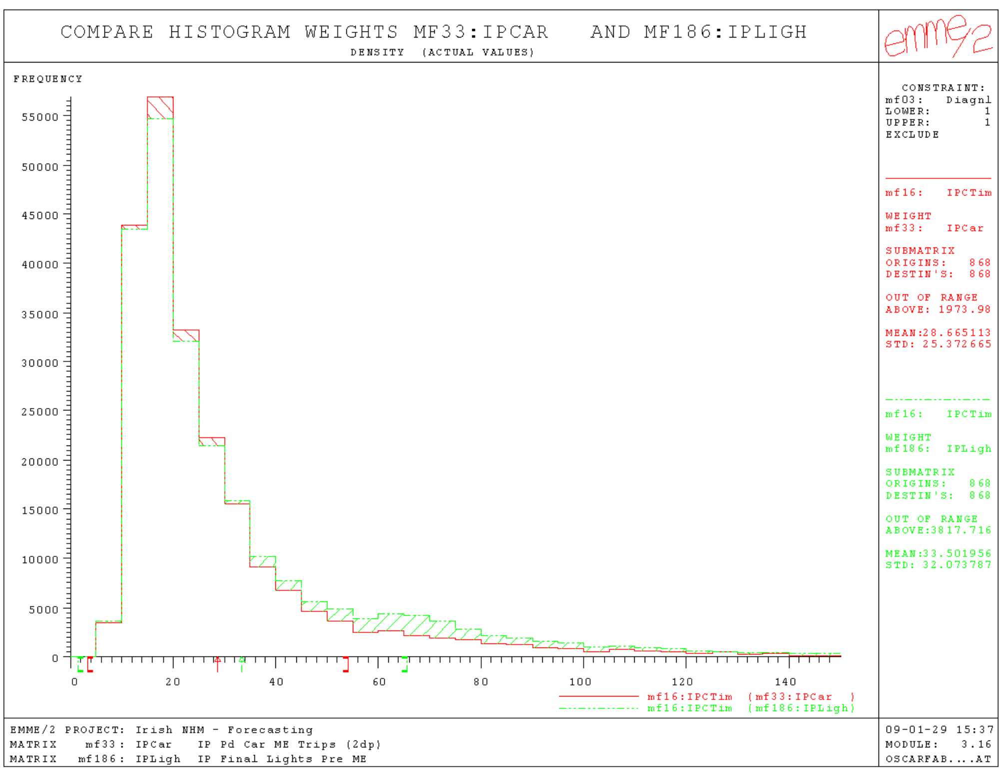
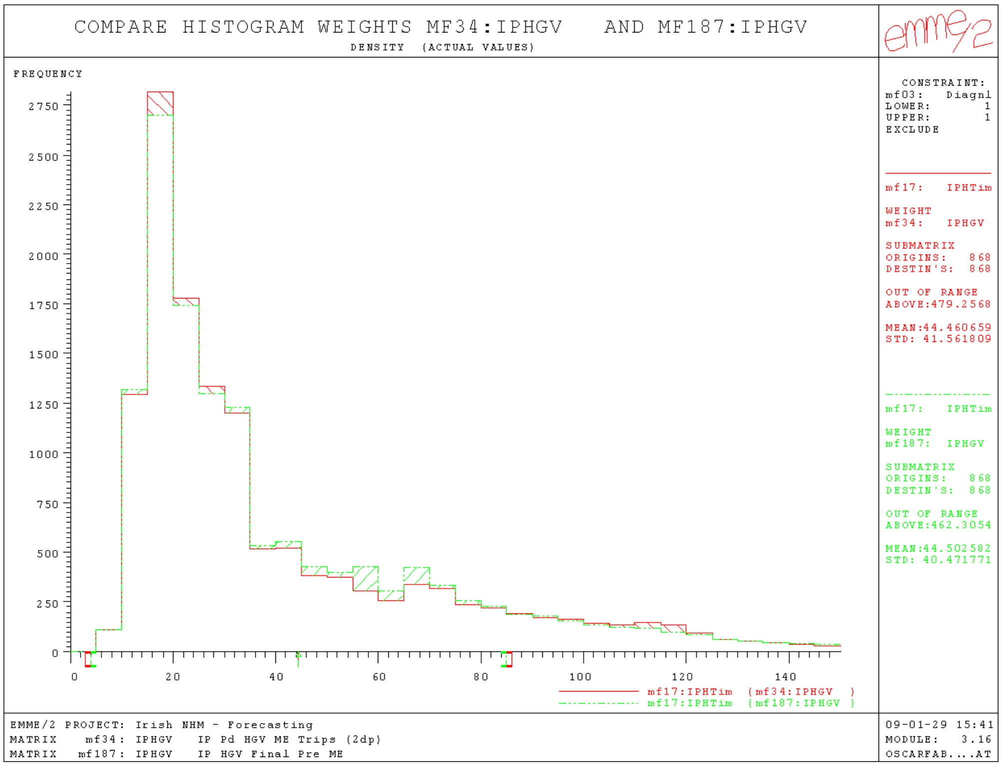


Figure 7.4: Comparison of pre and post estimation matrices (IP-Car)

Figure 7.5: Comparison of pre and post estimation matrices (IP-HGV)



7.2 Comparison of matrix totals and intrazonals

Tables 7.1 and 7.2 below show Pre and Post ME matrix and intrazonal trip totals, respectively.

Table 2.1 Pre ME trip totals and intrazonals

Matrices	Pre ME*		
	Matrix Totals	Intrazonals	
AM POWCAR	331,871	157,057	47%
AM Lights	185,559	75,856	41%
AM HGV	25,372	9,292	37%
IP Lights	442,159	195,160	44%
IP HGV	25,532	10,007	39%
Total	1,010,494	447,372	44%

Table 2.2 Post ME trip totals and intrazonals

Matrices	Post ME*		
	Matrix Totals	Intrazonals	
AM POWCAR	316,108	80,199	25%
AM Lights	173,084	75,844	44%
AM HGV	23,809	9,284	39%
IP Lights	428,290	195,175	46%
IP HGV	25,397	10,021	39%
Total	966,688	370,522	38%

*All totals summed using values to 5.d.p

The tables show that the magnitude of the Post ME matrix totals has on the whole been retained from the Pre ME matrices, and that the differences are only marginal. The magnitude and proportion of intrazonals, with the exception of POWCAR, have also been retained in the Post ME matrices. The POWCAR intrazonals have changed from 47% in the Pre ME to 25% in the Post ME.

The intrazonals are not assigned to the network and therefore unlikely to be affected during the matrix estimation process. However, the POWCAR intrazonals have reduced resulting in more inter (between) zone trips being created in the Post ME (the Pre and Post ME matrix totals are similar). This inter zonal increase is also evident in Figure 7.3 which compares the trips length distributions.

Appendix D
Model Calibration

AM Peak Calibration Total Traffic			FINAL Observed	Modelled	Difference		RESULT =	85.31 %		RESULT =	85.88%	
							REQD =	85.00%		REQD =	85.00%	
Link Number	Link Name	Link Capacity (PCU's)	Total Traffic	Total Traffic	Total Traffic	GEH	COUNT	GEH TEST	CLASS TEST	Target Difference	Flow Test	ACT DIFF
46090	Cork Street/N25	1600	823.00	643.00	-180.00	6.648	1	0	2	123	0	-180
46090	Cork Street/N25	1600	456.00	726.00	270.00	11.106	1	0	1	100	0	270
46396	Single C/W Regional Road	1350	94.00	109.00	15.00	1.489	1	1	1	100	1	15
46396	Single C/W Regional Road	1350	84.00	23.00	-61.00	8.340	1	0	1	100	1	-61
48111	N52/	1600	225.00	268.00	43.00	2.739	1	1	1	100	1	43
48111	N52/	1600	226.00	264.00	38.00	2.428	1	1	1	100	1	38
48981	N11/	1750	832.00	792.00	-40.00	1.404	1	1	2	125	1	-40
48981	N11/	1750	550.00	569.00	19.00	0.803	1	1	1	100	1	19
49902	N25/	1750	309.00	354.00	45.00	2.472	1	1	1	100	1	45
49902	N25/	1750	540.00	492.00	-48.00	2.113	1	1	1	100	1	-48
50644	N25/	1750	619.00	538.00	-81.00	3.368	1	1	1	100	1	-81
50644	N25/	1750	440.00	299.00	-141.00	7.335	1	0	1	100	0	-141
52964	N11/	1750	395.00	535.00	140.00	6.492	1	0	1	100	0	140
52964	N11/	1750	1083.00	1138.00	55.00	1.650	1	1	2	162	1	55
549453920	M1/	4850	828.00	822.00	-6.00	0.209	1	1	2	124	1	-6
549457910	M1/	4850	1512.00	1535.00	23.00	0.589	1	1	2	227	1	23
554498435	Birr Road/N62	1350	216.00	271.00	55.00	3.525	1	1	1	100	1	55
554498435	Birr Road/N62	1350	238.00	200.00	-38.00	2.568	1	1	1	100	1	-38
578632996	N8/	3500	2574.00	1766.00	-808.00	17.345	1	0	2	386	0	-808
578633000	N8/	3500	2013.00	860.00	-1153.00	30.421	1	0	2	302	0	-1153
590518411	North Road/N2	3500	957.00	1277.00	320.00	9.575	1	0	2	144	0	320
707720607	N9/	1750	561.00	524.00	-37.00	1.589	1	1	1	100	1	-37
707720607	N9/	1750	574.00	465.00	-109.00	4.782	1	1	1	100	0	-109
707795942	Tullowland/N81	1600	89.00	120.00	31.00	3.033	1	1	1	100	1	31
707795942	Tullowland/N81	1600	72.00	68.00	-4.00	0.478	1	1	1	100	1	-4
711409482	N18/	1750	974.00	971.00	-3.00	0.096	1	1	2	146	1	-3
711409482	N18/	1750	651.00	693.00	42.00	1.620	1	1	1	100	1	42
713873537	N85/	1600	121.00	87.00	-34.00	3.334	1	1	1	100	1	-34
713873537	N85/	1600	245.00	187.00	-58.00	3.946	1	1	1	100	1	-58
721886130	M50/	4850	2952.00	2046.00	-906.00	18.124	1	0	2	443	0	-906
732246005	M50/	4850	3479.00	2935.00	-544.00	9.606	1	0	2	522	0	-544

734302647	M50/	4850	2270.00	3179.00	909.00	17.415	1	0	2	341	0	909
737029553	M50/	4850	2458.00	3570.00	1112.00	20.255	1	0	2	369	0	1112
737298738	M50/	4850	2438.00	3282.00	844.00	15.782	1	0	2	366	0	844
738372033	M50/	4850	3232.00	3140.00	-92.00	1.630	1	1	2	485	1	-92
739888955	Single C/W Regional Road	1350	777.00	747.00	-30.00	1.087	1	1	2	117	1	-30
739888955	Single C/W Regional Road	1350	611.00	445.00	-166.00	7.224	1	0	1	100	0	-166
744349277	M50/	4850	3379.00	3515.00	136.00	2.316	1	1	2	507	1	136
748209843	M50/	4850	3110.00	2089.00	-1021.00	20.025	1	0	2	467	0	-1021
749152655	North Road/N2	3500	1650.00	2497.00	847.00	18.601	1	0	2	248	0	847
822827223	N20/	3500	1336.00	1485.00	149.00	3.967	1	1	2	200	1	149
840457703	N20/	1750	584.00	561.00	-23.00	0.961	1	1	1	100	1	-23
840457703	N20/	1750	475.00	386.00	-89.00	4.289	1	1	1	100	1	-89
844431948	N71/	1600	128.00	95.00	-33.00	3.125	1	1	1	100	1	-33
844431948	N71/	1600	137.00	90.00	-47.00	4.412	1	1	1	100	1	-47
848330505	N20/	3500	591.00	657.00	66.00	2.642	1	1	1	100	1	66
848817473	N71/	1600	128.00	91.00	-37.00	3.536	1	1	1	100	1	-37
848817473	N71/	1600	214.00	159.00	-55.00	4.027	1	1	1	100	1	-55
894267755	N56/	1600	142.00	60.00	-82.00	8.159	1	0	1	100	1	-82
894267755	N56/	1600	216.00	161.00	-55.00	4.006	1	1	1	100	1	-55
903954905	N13/	3500	1326.00	1323.00	-3.00	0.082	1	1	2	199	1	-3
904153130	N13/	3500	1573.00	1545.00	-28.00	0.709	1	1	2	236	1	-28
917969580	Ennis Road/N18	1600	369.00	347.00	-22.00	1.163	1	1	1	100	1	-22
917969580	Ennis Road/N18	1600	367.00	301.00	-66.00	3.611	1	1	1	100	1	-66
956021447	N6/	3500	1117.00	1033.00	-84.00	2.562	1	1	2	168	1	-84
1004232155	N17/	1750	510.00	574.00	64.00	2.749	1	1	1	100	1	64
1004232155	N17/	1750	792.00	745.00	-47.00	1.695	1	1	2	119	1	-47
1005085280	Clifden Road/N59	1600	210.00	364.00	154.00	9.090	1	0	1	100	0	154
1005085280	Clifden Road/N59	1600	709.00	793.00	84.00	3.065	1	1	2	106	1	84
1008093122	N83/	1600	196.00	212.00	16.00	1.120	1	1	1	100	1	16
1008093122	N83/	1600	132.00	119.00	-13.00	1.160	1	1	1	100	1	-13
1008313802	N18/	1750	381.00	303.00	-78.00	4.218	1	1	1	100	1	-78
1008313802	N18/	1750	464.00	454.00	-10.00	0.467	1	1	1	100	1	-10
1008485498	N66/	1600	40.00	59.00	19.00	2.701	1	1	1	100	1	19
1008485498	N66/	1600	95.00	59.00	-36.00	4.103	1	1	1	100	1	-36
1008559097	N6/	3500	1711.00	1648.00	-63.00	1.537	1	1	2	257	1	-63
1008976328	N17/	1750	235.00	177.00	-58.00	4.041	1	1	1	100	1	-58
1008976328	N17/	1750	278.00	214.00	-64.00	4.080	1	1	1	100	1	-64

1020475872	N21/	1600	317.00	332.00	15.00	0.833	1	1	1	100	1	15
1020475872	N21/	1600	276.00	363.00	87.00	4.867	1	1	1	100	1	87
1037614838	Muckross Road/N71	1350	112.00	111.00	-1.00	0.095	1	1	1	100	1	-1
1037614838	Muckross Road/N71	1350	147.00	153.00	6.00	0.490	1	1	1	100	1	6
1062233280	N22/	1750	278.00	250.00	-28.00	1.723	1	1	1	100	1	-28
1062233280	N22/	1750	286.00	279.00	-7.00	0.416	1	1	1	100	1	-7
1077766697	N70/	1600	272.00	260.00	-12.00	0.736	1	1	1	100	1	-12
1077766697	N70/	1600	175.00	178.00	3.00	0.226	1	1	1	100	1	3
1077848330	N70/	1600	164.00	171.00	7.00	0.541	1	1	1	100	1	7
1077848330	N70/	1600	250.00	216.00	-34.00	2.227	1	1	1	100	1	-34
1117183383	M7/	4850	1598.00	1842.00	244.00	5.883	1	0	2	240	0	244
1119246723	M7/	4850	1306.00	1530.00	224.00	5.949	1	0	2	196	0	224
1122956505	M7/	4850	809.00	792.00	-17.00	0.601	1	1	2	121	1	-17
1124341137	M7/	4850	801.00	872.00	71.00	2.455	1	1	2	120	1	71
1128799052	Single C/W Regional Road	1350	195.00	138.00	-57.00	4.417	1	1	1	100	1	-57
1128799052	Single C/W Regional Road	1350	134.00	98.00	-36.00	3.343	1	1	1	100	1	-36
1130251527	Single C/W Regional Road	1350	129.00	81.00	-48.00	4.684	1	1	1	100	1	-48
1130251527	Single C/W Regional Road	1350	145.00	98.00	-47.00	4.264	1	1	1	100	1	-47
1181615697	N24/	1750	344.00	165.00	-179.00	11.220	1	0	1	100	0	-179
1181615697	N24/	1750	357.00	319.00	-38.00	2.067	1	1	1	100	1	-38
1200866597	M7/	4850	726.00	283.00	-443.00	19.723	1	0	2	109	0	-443
1215612002	M7/	4850	667.00	402.00	-265.00	11.462	1	0	1	100	0	-265
1227280932	M7/	4850	387.00	449.00	62.00	3.033	1	1	1	100	1	62
1230186537	M7/	4850	490.00	508.00	18.00	0.806	1	1	1	100	1	18
1231383413	N78/	1600	207.00	147.00	-60.00	4.510	1	1	1	100	1	-60
1231383413	N78/	1600	81.00	45.00	-36.00	4.536	1	1	1	100	1	-36
1294719030	N18/	3500	1318.00	1456.00	138.00	3.705	1	1	2	198	1	138
1352442080	N18/	3500	1629.00	1780.00	151.00	3.657	1	1	2	244	1	151
1353376143	N24/	1750	343.00	355.00	12.00	0.642	1	1	1	100	1	12
1353376143	N24/	1750	640.00	640.00	0.00	0.000	1	1	1	100	1	0
1367322902	N20/	3500	1242.00	974.00	-268.00	8.051	1	0	2	186	0	-268
1368122283	N20/	3500	1232.00	1234.00	2.00	0.057	1	1	2	185	1	2
1558802682	N60/	1600	66.00	97.00	31.00	3.434	1	1	1	100	1	31
1558802682	N60/	1600	72.00	71.00	-1.00	0.118	1	1	1	100	1	-1
1562437478	N5/	1750	329.00	333.00	4.00	0.220	1	1	1	100	1	4

1562437478	N5/	1750	379.00	374.00	-5.00	0.258	1	1	1	100	1	-5
1563388758	N26/	1750	82.00	120.00	38.00	3.781	1	1	1	100	1	38
1563388758	N26/	1750	99.00	103.00	4.00	0.398	1	1	1	100	1	4
1564009443	N59/	1600	59.00	67.00	8.00	1.008	1	1	1	100	1	8
1564009443	N59/	1600	105.00	107.00	2.00	0.194	1	1	1	100	1	2
1564299173	N84/	1600	89.00	80.00	-9.00	0.979	1	1	1	100	1	-9
1564299173	N84/	1600	114.00	101.00	-13.00	1.254	1	1	1	100	1	-13
1565375742	N59/	1600	149.00	189.00	40.00	3.077	1	1	1	100	1	40
1565375742	N59/	1600	131.00	134.00	3.00	0.261	1	1	1	100	1	3
1565955713	N17/	1750	147.00	97.00	-50.00	4.527	1	1	1	100	1	-50
1565955713	N17/	1750	174.00	128.00	-46.00	3.743	1	1	1	100	1	-46
1566038582	N5/	1750	239.00	229.00	-10.00	0.654	1	1	1	100	1	-10
1566038582	N5/	1750	286.00	255.00	-31.00	1.885	1	1	1	100	1	-31
1649867418	N51/	1600	212.00	280.00	68.00	4.336	1	1	1	100	1	68
1649867418	N51/	1600	246.00	274.00	28.00	1.736	1	1	1	100	1	28
1761199812	N62/	1600	226.00	225.00	-1.00	0.067	1	1	1	100	1	-1
1761199812	N62/	1600	160.00	208.00	48.00	3.539	1	1	1	100	1	48
1764047813	N62/	1600	176.00	219.00	43.00	3.060	1	1	1	100	1	43
1764047813	N62/	1600	196.00	305.00	109.00	6.887	1	0	1	100	0	109
2103858842	N24/	1750	209.00	222.00	13.00	0.886	1	1	1	100	1	13
2103858842	N24/	1750	162.00	144.00	-18.00	1.455	1	1	1	100	1	-18
2116357992	N7/	1750	261.00	192.00	-69.00	4.585	1	1	1	100	1	-69
2147474833	N61/	1600	225.00	191.00	-34.00	2.357	1	1	1	100	1	-34
2147474833	N61/	1600	498.00	446.00	-52.00	2.393	1	1	1	100	1	-52
2147474902	N5/	1750	434.00	510.00	76.00	3.498	1	1	1	100	1	76
2147474902	N5/	1750	273.00	292.00	19.00	1.130	1	1	1	100	1	19
2147474926	N59/	1600	172.00	168.00	-4.00	0.307	1	1	1	100	1	-4
2147474926	N59/	1600	106.00	143.00	37.00	3.316	1	1	1	100	1	37
2147475096	N84/	1600	132.00	152.00	20.00	1.678	1	1	1	100	1	20
2147475096	N84/	1600	135.00	191.00	56.00	4.386	1	1	1	100	1	56
2147475112	Galway Road/N59	1600	42.00	42.00	0.00	0.000	1	1	1	100	1	0
2147475112	Galway Road/N59	1600	59.00	86.00	27.00	3.171	1	1	1	100	1	27
2147475163	N6/	1750	466.00	465.00	-1.00	0.046	1	1	1	100	1	-1
2147475163	N6/	1750	488.00	458.00	-30.00	1.379	1	1	1	100	1	-30
2147475190	N2/	1750	494.00	525.00	31.00	1.373	1	1	1	100	1	31

2147475190	N2/	1750	307.00	264.00	-43.00	2.545	1	1	1	100	1	-43
2147475278	N15/	1750	275.00	304.00	29.00	1.704	1	1	1	100	1	29
2147475278	N15/	1750	393.00	405.00	12.00	0.601	1	1	1	100	1	12
2147475489	N55/	1600	357.00	356.00	-1.00	0.053	1	1	1	100	1	-1
2147475489	N55/	1600	441.00	415.00	-26.00	1.257	1	1	1	100	1	-26
2147475540	Dublin Road/N3	1750	367.00	298.00	-69.00	3.784	1	1	1	100	1	-69
2147475540	Dublin Road/N3	1750	381.00	340.00	-41.00	2.159	1	1	1	100	1	-41
2147475584	N52/	1600	343.00	282.00	-61.00	3.451	1	1	1	100	1	-61
2147475584	N52/	1600	175.00	144.00	-31.00	2.455	1	1	1	100	1	-31
2147475733	N6/	1750	397.00	383.00	-14.00	0.709	1	1	1	100	1	-14
2147475733	N6/	1750	546.00	554.00	8.00	0.341	1	1	1	100	1	8
2147475734	N80/	1600	422.00	364.00	-58.00	2.926	1	1	1	100	1	-58
2147475734	N80/	1600	315.00	323.00	8.00	0.448	1	1	1	100	1	8
2147475742	N20/	1750	617.00	616.00	-1.00	0.040	1	1	1	100	1	-1
2147475742	N20/	1750	1071.00	1108.00	37.00	1.121	1	1	2	161	1	37
2147475786	N72/	1600	185.00	259.00	74.00	4.967	1	1	1	100	1	74
2147475786	N72/	1600	277.00	345.00	68.00	3.856	1	1	1	100	1	68
2147475859	N80/	1600	297.00	242.00	-55.00	3.350	1	1	1	100	1	-55
2147475859	N80/	1600	245.00	263.00	18.00	1.129	1	1	1	100	1	18
2147475901	N72/	1600	114.00	154.00	40.00	3.455	1	1	1	100	1	40
2147475901	N72/	1600	109.00	127.00	18.00	1.657	1	1	1	100	1	18
2147475921	N22/	1750	254.00	188.00	-66.00	4.440	1	1	1	100	1	-66
2147475921	N22/	1750	302.00	240.00	-62.00	3.766	1	1	1	100	1	-62
2147475929	N8/	1750	410.00	345.00	-65.00	3.345	1	1	1	100	1	-65
2147475929	N8/	1750	592.00	635.00	43.00	1.736	1	1	1	100	1	43
2147475935	Portlaoise Road/N7	1750	435.00	496.00	61.00	2.827	1	1	1	100	1	61
2147475935	Portlaoise Road/N7	1750	535.00	588.00	53.00	2.237	1	1	1	100	1	53
2147475976	N20/	1750	360.00	404.00	44.00	2.251	1	1	1	100	1	44
2147475976	N20/	1750	735.00	765.00	30.00	1.095	1	1	2	110	1	30
2147476263	N25/	1750	699.00	619.00	-80.00	3.116	1	1	1	100	1	-80
2147476263	N25/	1750	531.00	480.00	-51.00	2.268	1	1	1	100	1	-51
2147476296	N86/	1600	73.00	102.00	29.00	3.100	1	1	1	100	1	29
2147476296	N86/	1600	105.00	135.00	30.00	2.739	1	1	1	100	1	30
2147476319	N70/	1600	71.00	37.00	-34.00	4.627	1	1	1	100	1	-34
2147476319	N70/	1600	75.00	53.00	-22.00	2.750	1	1	1	100	1	-22

2147476338	Single C/W Regional Road	1350	233.00	114.00	-119.00	9.034	1	0	1	100	0	-119
2147476338	Single C/W Regional Road	1350	293.00	228.00	-65.00	4.027	1	1	1	100	1	-65
2147482960	N16/	1600	310.00	325.00	15.00	0.842	1	1	1	100	1	15
2147482960	N16/	1600	406.00	436.00	30.00	1.462	1	1	1	100	1	30
			98115	96536	-1579	5.061	177	151			152	5.061
				Average GEH		3.690						

AM Peak Model Calibration Summary

FINAL

TOTAL TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Total Traffic Observed	Total Traffic Modelled	Difference	Average GEH
177	151	85.31%	152	85.88%	98155	96536	-1579	3.690

LIGHT TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Light Traffic Observed	Light Traffic Modelled	Difference	Average GEH
177	152	85.88%	154	87.01%	89242	88887	-355	1.190

HEAVIES TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Heavies Traffic Observed	Heavies Traffic Modelled	Difference	Average GEH
177	163	92.09%	176	99.44%	8882	7648	-1234	2.590

Inter-Peak Model Calibration Summary

FINAL

TOTAL TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Total Traffic Observed	Total Traffic Modelled	Difference	Average GEH
177	160	92.09%	162	91.53%	86232	82695	-3537	2.499

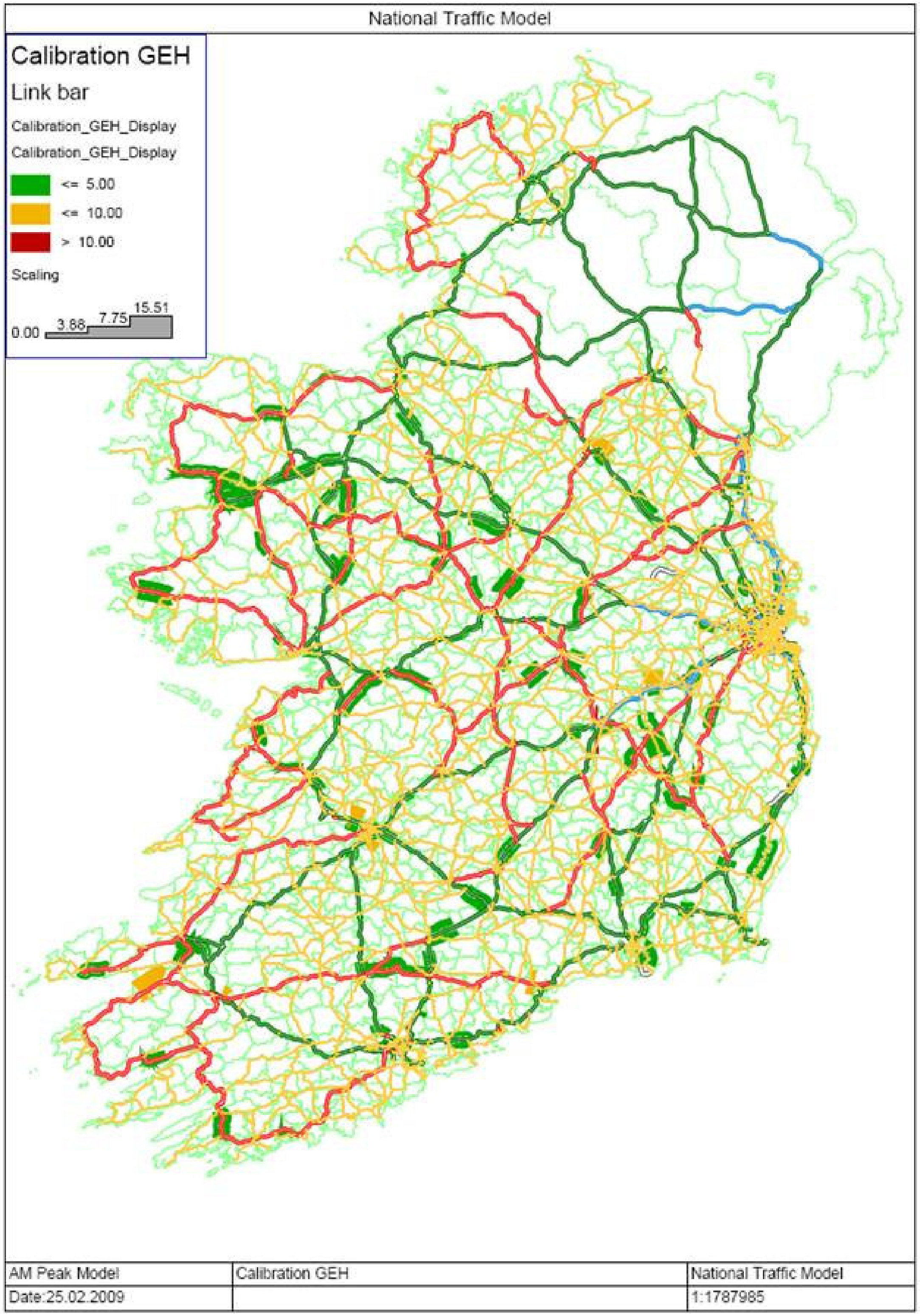
LIGHT TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Light Traffic Observed	Light Traffic Modelled	Difference	Average GEH
177	156	88.14%	163	92.09%	75949	73606	-2343	2.377

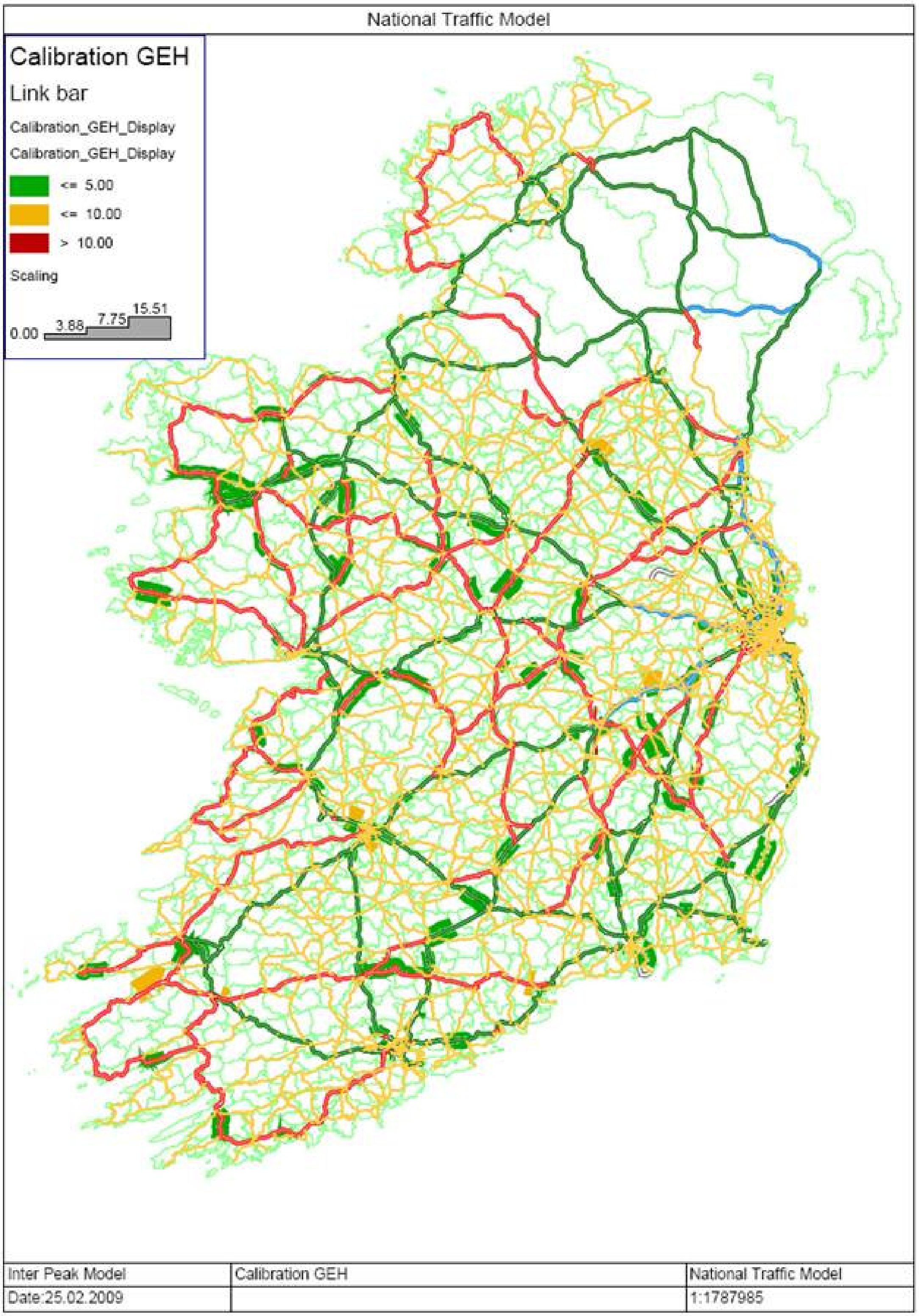
HEAVIES TRAFFIC

Number of Links	Links within GEH	Percentage Calibrated	Links Flow Criteria	Percentage Calibrated	Heavies Traffic Observed	Heavies Traffic Modelled	Difference	Average GEH
177	163	92.09%	175	98.87%	10381	9094	-1287	1.974

AM Peak Calibration Count GEH Network Plot



Inter Peak Calibration Count GEH Network Plot



AM Peak Screenline Calibration Summary

FINAL

Screenline 1

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	95.45%	RESULT =	95.45%
	REQD =	85.00%	REQD =	85.00%

	Number of Links	Observed Total Traffic	Modelled Total Traffic	Diff Total Traffic	*Average GEH*
SOUTHBOUND	11	3202	3158	-44	2.60
NORTHBOUND	11	2294	2056	-238	3.11
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	22	5496	5214	-282	3.85

Screenline 2

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	100.00%	RESULT =	100.00%
	REQD =	85.00%	REQD =	85.00%

	Number of Links	Observed Total Traffic	Modelled Total Traffic	Diff Total Traffic	*Average GEH*
NORTHBOUND	8	2661	2537	-124	2.91
SOUTHBOUND	8	2490	2483	-7	2.65
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	16	5151	5020	-131	1.84

Screenline 3

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	92.31%	RESULT =	92.31%
	REQD =	85.00%	REQD =	85.00%

	Number of Links	Observed Total Traffic	Modelled Total Traffic	Diff Total Traffic	*Average GEH*
EASTBOUND	13	5341	5056	-285	2.82
WESTBOUND	13	7315	6841	-471	2.61
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	26	12656	11897	-759	6.85

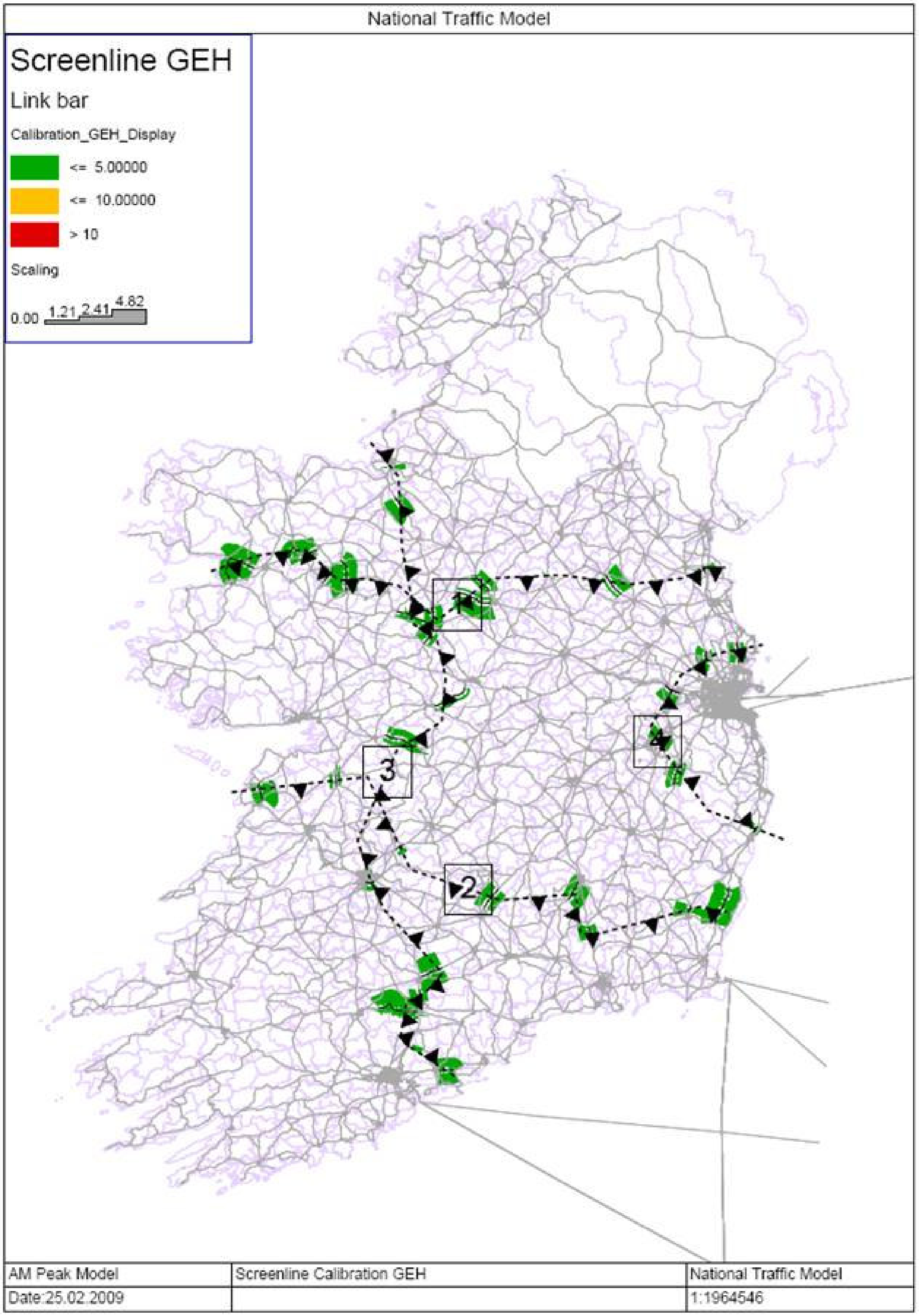
Screenline 4

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	91.67%	RESULT =	83.33%
	REQD =	85.00%	REQD =	85.00%

	Number of Links	Observed Total Traffic	Modelled Total Traffic	Diff Total Traffic	*Average GEH*
INBOUND TO DUBLIN	6	10652	11378	726	4.00
OUTBOUND FROM DUBLIN	6	4655	4847	192	2.09
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	12	15307	16225	918	7.31

AM Peak Screenline Calibration Count Network Plot



Inter-Peak Screenline Calibration Summary

FINAL

Screenline 1

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	91.67%	RESULT =	95.83%
	REQD =	85.00%	REQD =	85.00%

		Observed	Modelled	Diff	
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Average GEH*
SOUTHBOUND	12	2564	2522	-42	2.33
NORTHBOUND	12	2528	2704	176	2.30
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	24	5092	5226	134	1.87

Screenline 2

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	87.50%	RESULT =	93.75%
	REQD =	85.00%	REQD =	85.00%

		Observed	Modelled	Diff	
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Average GEH*
NORTHBOUND	8	2325	2323	-2	2.66
SOUTHBOUND	8	2359	2464	105	2.91
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	16	4684	4787	103	1.50

Screenline 3

Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	88.46%	RESULT =	84.62%
	REQD =	85.00%	REQD =	85.00%

		Observed	Modelled	Diff	
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Average GEH*
EASTBOUND	13	5119	4804	-315	2.38
WESTBOUND	13	5198	5108	-90	2.03
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	26	10317	9912	-405	4.03

Screenline 4

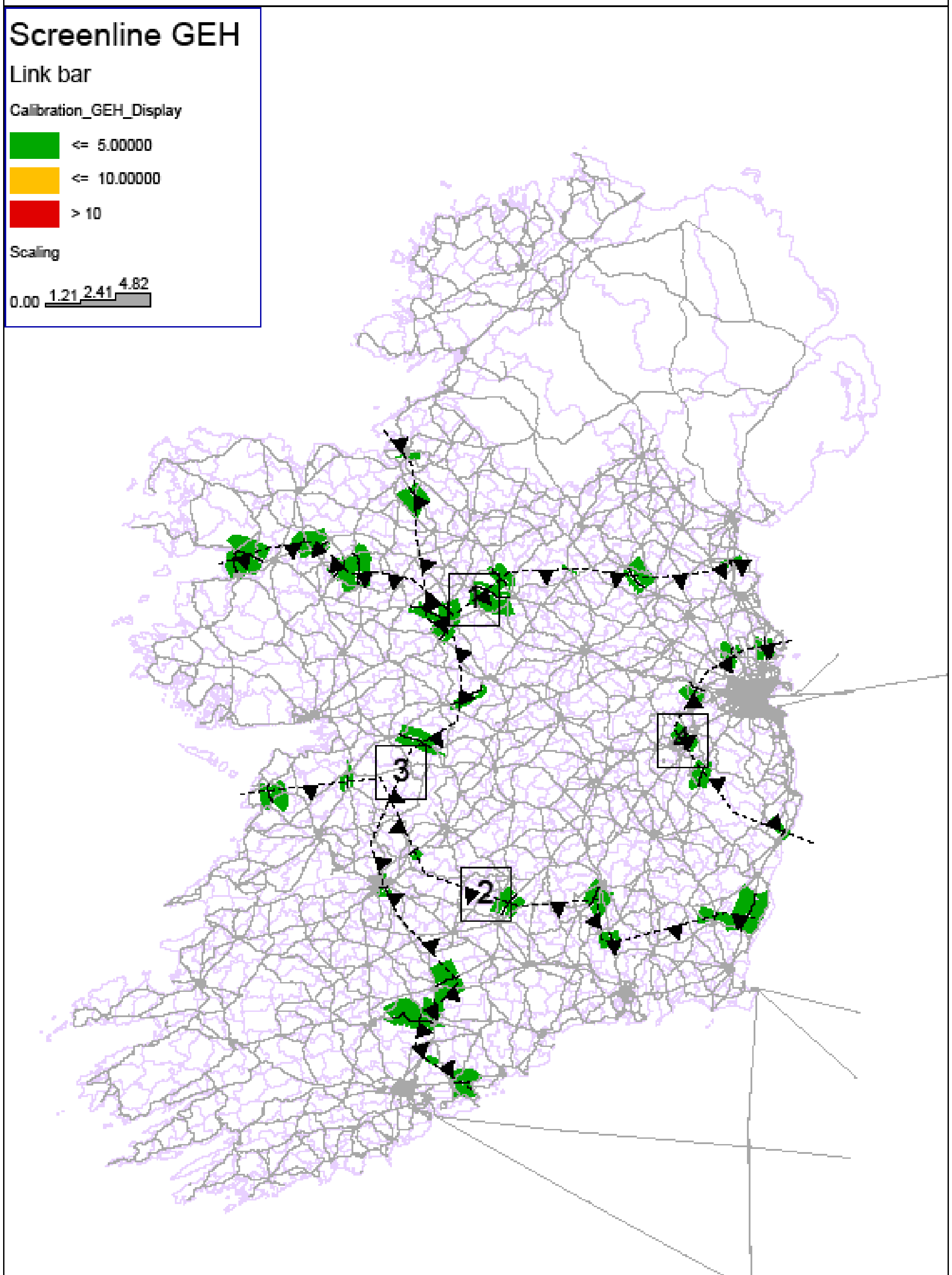
Overall Screenline Comparison

	GEH TEST		FLOW TEST	
	RESULT =	83.33%	RESULT =	75.00%
	REQD =	85.00%	REQD =	85.00%

		Observed	Modelled	Diff	
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Average GEH*
INBOUND TO DUBLIN	6	4800	5523	723	5.12
OUTBOUND FROM DUBLIN	6	5174	5635	461	3.37
	Number of Links	Total Traffic	Total Traffic	Total Traffic	*Total GEH*
TOTAL	12	9974	11158	1184	11.52

Inter-Peak Screenline Calibration Count Network Plot

National Traffic Model



Inter Peak Model	Screenline Calibration GEH	National Traffic Model
Date:26.02.2009		1:1964546

Appendix E
Model Validation

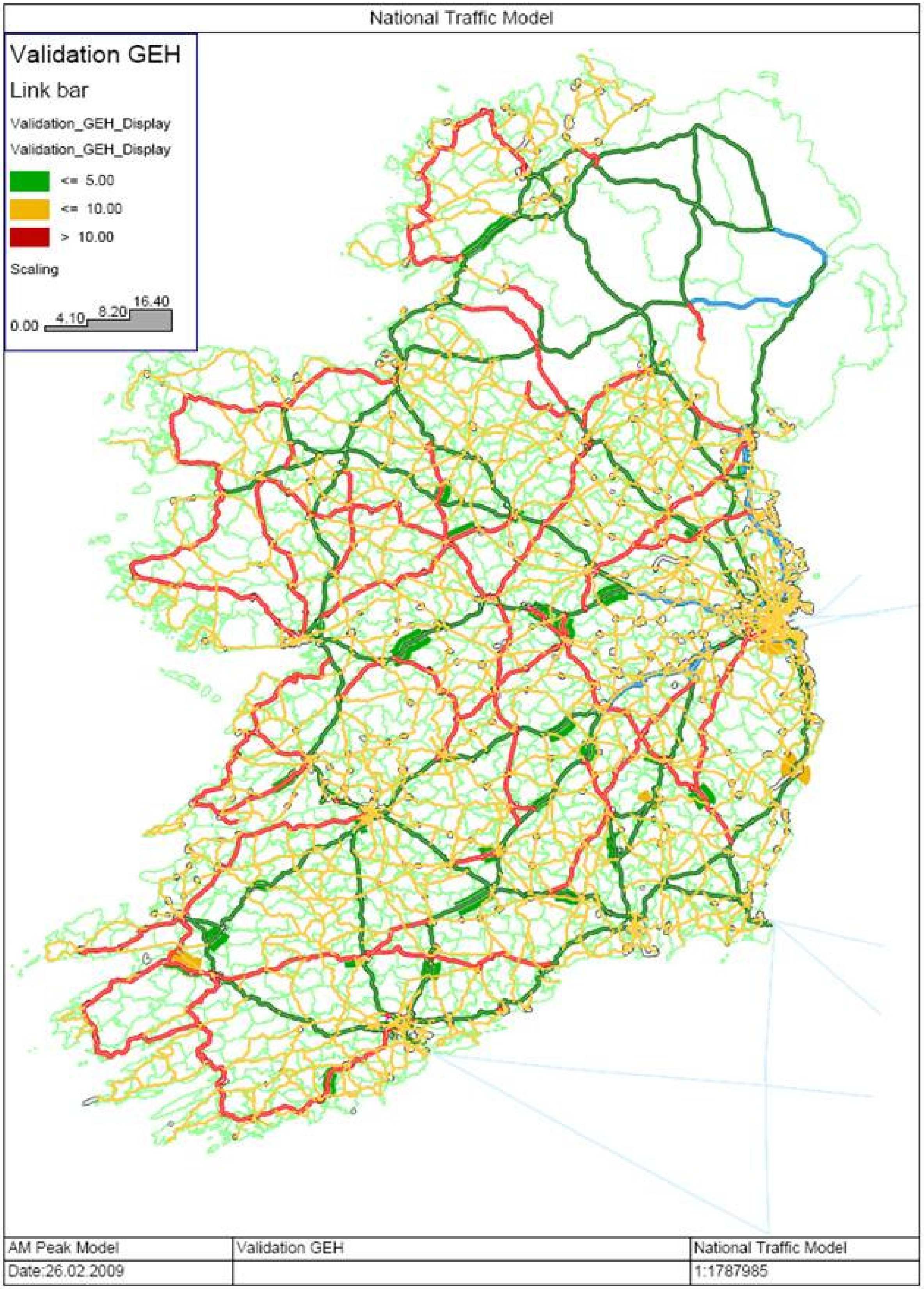
AM Peak Validation Total Traffic

Link Number	Link Name	Link Capacity (PCU's)	FINAL Observed Total Traffic	Modelled Total Traffic	Difference Total Traffic	GEH	COUNT	GEH TEST	CLASS TEST	Target Difference	Flow Test	ACT DIFF
							RESULT =	85.00 %		RESULT =	88.33%	
							REQD =	85.00%		REQD =	85.00%	
47910	N52/	1600	302.00	260.00	-42.00	2.506	1	1	1	100	1	-42
47910	N52/	1600	297.00	373.00	76.00	4.152	1	1	1	100	1	76
48139	Athlone Road/N6	1750	348.00	291.00	-57.00	3.189	1	1	1	100	1	-57
48139	Athlone Road/N6	1750	393.00	285.00	-88.00	4.852	1	1	1	100	1	-88
52726	N11/	3500	943.00	834.00	-109.00	3.657	1	1	2	141	1	-109
52937	N11/	3500	420.00	333.00	-87.00	4.484	1	1	1	100	1	-87
740138598	M50/	4850	3411.00	3911.00	500.00	8.264	1	0	3	800	1	500
750097062	M50/	4850	2542.00	3399.00	857.00	15.724	1	0	2	381	0	857
751108037	M50/	4850	3637.00	3943.00	306.00	4.971	1	1	3	800	1	306
752528192	M50/	4850	2999.00	3269.00	270.00	4.823	1	1	3	800	1	270
843045822	N8/	1750	510.00	529.00	19.00	0.834	1	1	1	100	1	19
843045822	N8/	1750	687.00	733.00	46.00	1.726	1	1	1	100	1	46
1010106755	N6/	1750	354.00	269.00	-85.00	4.816	1	1	1	100	1	-85
1010106755	N6/	1750	249.00	182.00	-67.00	4.564	1	1	1	100	1	-67
1075484627	N23/	1750	119.00	180.00	61.00	4.989	1	1	1	100	1	61
1075484627	N23/	1750	142.00	179.00	37.00	2.921	1	1	1	100	1	37
1179923732	N9/	1750	507.00	481.00	-26.00	1.170	1	1	1	100	1	-26
1179923732	N9/	1750	683.00	439.00	-244.00	10.302	1	0	1	100	0	-244
1230574563	N7/	1750	330.00	442.00	112.00	5.701	1	0	1	100	0	112
1230574563	N7/	1750	452.00	432.00	-20.00	0.951	1	1	1	100	1	-20
1370778242	N21/	1750	336.00	352.00	16.00	0.863	1	1	1	100	1	16
1370778242	N21/	1750	267.00	313.00	46.00	2.701	1	1	1	100	1	46
1401276380	N4/	1750	284.00	224.00	-60.00	3.765	1	1	1	100	1	-60
1401276380	N4/	1750	261.00	285.00	24.00	1.453	1	1	1	100	1	24
1430861813	M1/	4850	1258.00	1103.00	-155.00	4.511	1	1	2	189	1	-155

1433755247	M1/	4850	826.00	743.00	-83.00	2.963	1	1	2	124	1	-83
1768188848	N80/	1600	291.00	304.00	13.00	0.754	1	1	1	100	1	13
1768188848	N80/	1600	426.00	364.00	-62.00	3.120	1	1	1	100	1	-62
1853620002	N63/	1600	189.00	179.00	-10.00	0.737	1	1	1	100	1	-10
1853620002	N63/	1600	183.00	177.00	-6.00	0.447	1	1	1	100	1	-6
1855248347	N61/	1600	95.00	93.00	-2.00	0.206	1	1	1	100	1	-2
1855248347	N61/	1600	102.00	96.00	-6.00	0.603	1	1	1	100	1	-6
2100109403	N8/	1750	335.00	295.00	-40.00	2.254	1	1	1	100	1	-40
2100109403	N8/	1750	431.00	360.00	-71.00	3.570	1	1	1	100	1	-71
2112432773	N24/	1750	320.00	305.00	-15.00	0.849	1	1	1	100	1	-15
2112432773	N24/	1750	403.00	379.00	-24.00	1.214	1	1	1	100	1	-24
2116092602	N74/	1600	168.00	218.00	50.00	3.599	1	1	1	100	1	50
2116092602	N74/	1600	116.00	86.00	-30.00	2.985	1	1	1	100	1	-30
2147475073	N68/	1600	341.00	286.00	-55.00	3.106	1	1	1	100	1	-55
2147475073	N68/	1600	257.00	203.00	-54.00	3.561	1	1	1	100	1	-54
2147475143	N18/	1750	128.00	144.00	16.00	1.372	1	1	1	100	1	16
2147475143	N18/	1750	288.00	218.00	-70.00	4.401	1	1	1	100	1	-70
2147475279	N15/	1750	200.00	255.00	55.00	3.646	1	1	1	100	1	55
2147475279	N15/	1750	285.00	272.00	-13.00	0.779	1	1	1	100	1	-13
2147475773	Clonakilty Road/N71	1600	235.00	230.00	-5.00	0.328	1	1	1	100	1	-5
2147475773	Clonakilty Road/N71	1600	352.00	305.00	-47.00	2.593	1	1	1	100	1	-47
2147475906	N72/	1600	128.00	153.00	25.00	2.109	1	1	1	100	1	25
2147475906	N72/	1600	418.00	359.00	-59.00	2.993	1	1	1	100	1	-59
2147475918	N72/	1600	547.00	334.00	-213.00	10.149	1	0	1	100	0	-213
2147475918	N72/	1600	294.00	261.00	-33.00	1.981	1	1	1	100	1	-33
2147475926	Single C/W Regional Road	1350	125.00	132.00	7.00	0.618	1	1	1	100	1	7
2147475926	Single C/W Regional Road	1350	248.00	258.00	10.00	0.629	1	1	1	100	1	10
2147475956	N10/	1750	310.00	247.00	-63.00	3.775	1	1	1	100	1	-63
2147475956	N10/	1750	208.00	186.00	-22.00	1.567	1	1	1	100	1	-22
2147476026	N8/	1750	324.00	172.00	-152.00	9.652	1	0	1	100	0	-152
2147476026	N8/	1750	434.00	270.00	-164.00	8.741	1	0	1	100	0	-164

2147476067	**N80/**	**1600**	**185.00**	332.00	147.00	**9.143**	**1**	**0**	**1**	**100**	**0**	**147**
2147476067	**N80/**	**1600**	**380.00**	281.00	-99.00	**5.446**	**1**	**0**	**1**	**100**	**1**	**-99**
2147476415	**N3/**	**1750**	**334.00**	384.00	50.00	**2.639**	**1**	**1**	**1**	**100**	**1**	**50**
2147476415	**N3/**	**1750**	**618.00**	649.00	31.00	**1.232**	**1**	**1**	**1**	**100**	**1**	**31**
			32255	32571	336	1.867	60	**51**			**53**	
				Average GEH		**3.527**						

AM Peak Validation Count GEH Network Plot



Inter Peak Validation Total Traffic			FINAL				RESULT =	93.33 %		RESULT =	96.67%	
			Observed	Modelled	Difference		REQD =	85.00%		REQD =	85.00%	
Link Number	Link Name	Link Capacity (PCU's)	Total Traffic	Total Traffic	Total Traffic	GEH	COUNT	GEH TEST	CLASS TEST	Target Difference	Flow Test	ACT DIFF
47910	N52/	1600	320.00	324.00	4.00	0.223	1	1	1	100	1	4
47910	N52/	1600	285.00	283.00	-2.00	0.119	1	1	1	100	1	-2
48139	Athlone Road/N6	1750	370.00	327.00	-43.00	2.303	1	1	1	100	1	-43
48139	Athlone Road/N6	1750	366.00	304.00	-62.00	3.387	1	1	1	100	1	-62
52726	N11/	3500	526.00	502.00	-24.00	1.059	1	1	1	100	1	-24
52937	N11/	3500	584.00	550.00	-34.00	1.428	1	1	1	100	1	-34
740138598	M50/	4850	3048.00	3613.00	565.00	9.790	1	0	2	457	0	565
750097062	M50/	4850	2867.00	3149.00	282.00	5.142	1	0	2	430	1	282
751108037	M50/	4850	2430.00	2579.00	149.00	2.977	1	1	2	365	1	149
752528192	M50/	4850	2509.00	2673.00	164.00	3.222	1	1	2	376	1	164
843045822	N8/	1750	505.00	511.00	6.00	0.266	1	1	1	100	1	6
843045822	N8/	1750	483.00	486.00	3.00	0.136	1	1	1	100	1	3
1010106755	N6/	1750	323.00	273.00	-50.00	2.896	1	1	1	100	1	-50
1010106755	N6/	1750	307.00	264.00	-43.00	2.545	1	1	1	100	1	-43
1075484627	N23/	1750	126.00	130.00	4.00	0.354	1	1	1	100	1	4
1075484627	N23/	1750	173.00	172.00	-1.00	0.076	1	1	1	100	1	-1
1179923732	N9/	1750	449.00	438.00	-11.00	0.522	1	1	1	100	1	-11
1179923732	N9/	1750	455.00	426.00	-29.00	1.382	1	1	1	100	1	-29
1230574563	N7/	1750	383.00	369.00	-14.00	0.722	1	1	1	100	1	-14
1230574563	N7/	1750	355.00	346.00	-9.00	0.481	1	1	1	100	1	-9
1370778242	N21/	1750	320.00	318.00	-2.00	0.112	1	1	1	100	1	-2
1370778242	N21/	1750	324.00	327.00	3.00	0.166	1	1	1	100	1	3
1401276380	N4/	1750	313.00	256.00	-57.00	3.379	1	1	1	100	1	-57
1401276380	N4/	1750	341.00	285.00	-56.00	3.165	1	1	1	100	1	-56

1430861813	M1/	4850	770.00	599.00	-171.00	6.536	1	0	2	116	0	-171
1433755247	M1/	4850	803.00	695.00	-108.00	3.946	1	1	2	120	1	-108
1768188848	N80/	1600	298.00	286.00	-12.00	0.702	1	1	1	100	1	-12
1768188848	N80/	1600	285.00	289.00	4.00	0.236	1	1	1	100	1	4
1853620002	N63/	1600	171.00	136.00	-35.00	2.825	1	1	1	100	1	-35
1853620002	N63/	1600	194.00	179.00	-15.00	1.098	1	1	1	100	1	-15
1855248347	N61/	1600	86.00	89.00	3.00	0.321	1	1	1	100	1	3
1855248347	N61/	1600	92.00	101.00	9.00	0.916	1	1	1	100	1	9
2100109403	N8/	1750	393.00	375.00	-18.00	0.919	1	1	1	100	1	-18
2100109403	N8/	1750	382.00	365.00	-17.00	0.880	1	1	1	100	1	-17
2112432773	N24/	1750	285.00	203.00	-82.00	5.250	1	0	1	100	1	-82
2112432773	N24/	1750	276.00	247.00	-29.00	1.793	1	1	1	100	1	-29
2116092602	N74/	1600	137.00	141.00	4.00	0.339	1	1	1	100	1	4
2116092602	N74/	1600	138.00	131.00	-7.00	0.604	1	1	1	100	1	-7
2147475073	N68/	1600	197.00	182.00	-15.00	1.090	1	1	1	100	1	-15
2147475073	N68/	1600	212.00	203.00	-9.00	0.625	1	1	1	100	1	-9
2147475143	N18/	1750	163.00	149.00	-14.00	1.121	1	1	1	100	1	-14
2147475143	N18/	1750	356.00	316.00	-40.00	2.182	1	1	1	100	1	-40
2147475279	N15/	1750	225.00	233.00	8.00	0.529	1	1	1	100	1	8
2147475279	N15/	1750	228.00	243.00	15.00	0.977	1	1	1	100	1	15
2147475773	Clonakilty Road/N71	1600	229.00	207.00	-22.00	1.490	1	1	1	100	1	-22
2147475773	Clonakilty Road/N71	1600	238.00	213.00	-25.00	1.665	1	1	1	100	1	-25
2147475906	N72/	1600	162.00	164.00	2.00	0.157	1	1	1	100	1	2
2147475906	N72/	1600	239.00	229.00	-10.00	0.654	1	1	1	100	1	-10
2147475918	N72/	1600	409.00	362.00	-47.00	2.394	1	1	1	100	1	-47
2147475918	N72/	1600	418.00	366.00	-52.00	2.626	1	1	1	100	1	-52
2147475926	Single C/W Regional Road	1350	180.00	180.00	0.00	0.000	1	1	1	100	1	0
2147475926	Single C/W Regional Road	1350	156.00	159.00	3.00	0.239	1	1	1	100	1	3
2147475956	N10/	1750	205.00	183.00	-22.00	1.580	1	1	1	100	1	-22
2147475956	N10/	1750	220.00	197.00	-23.00	1.593	1	1	1	100	1	-23
2147476026	N8/	1750	402.00	345.00	-57.00	2.949	1	1	1	100	1	-57

2147476026	N8/	1750	390.00	338.00	-52.00	2.726	1	1	1	100	1	-52
2147476067	N80/	1600	181.00	182.00	1.00	0.074	1	1	1	100	1	1
2147476067	N80/	1600	193.00	190.00	-3.00	0.217	1	1	1	100	1	-3
2147476415	N3/	1750	414.00	432.00	18.00	0.875	1	1	1	100	1	18
2147476415	N3/	1750	393.00	383.00	-10.00	0.508	1	1	1	100	1	-10
			28282	28197	-85	0.506	60	56			58	
				Average GEH		1.641						

Inter-Peak Validation Count GEH Network Plot